MAR 28 1921

March 24, 1921

Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

In This Issue:

Designing the Ring Girder Foundations for New York City Courthouse
By C. S. Proctor

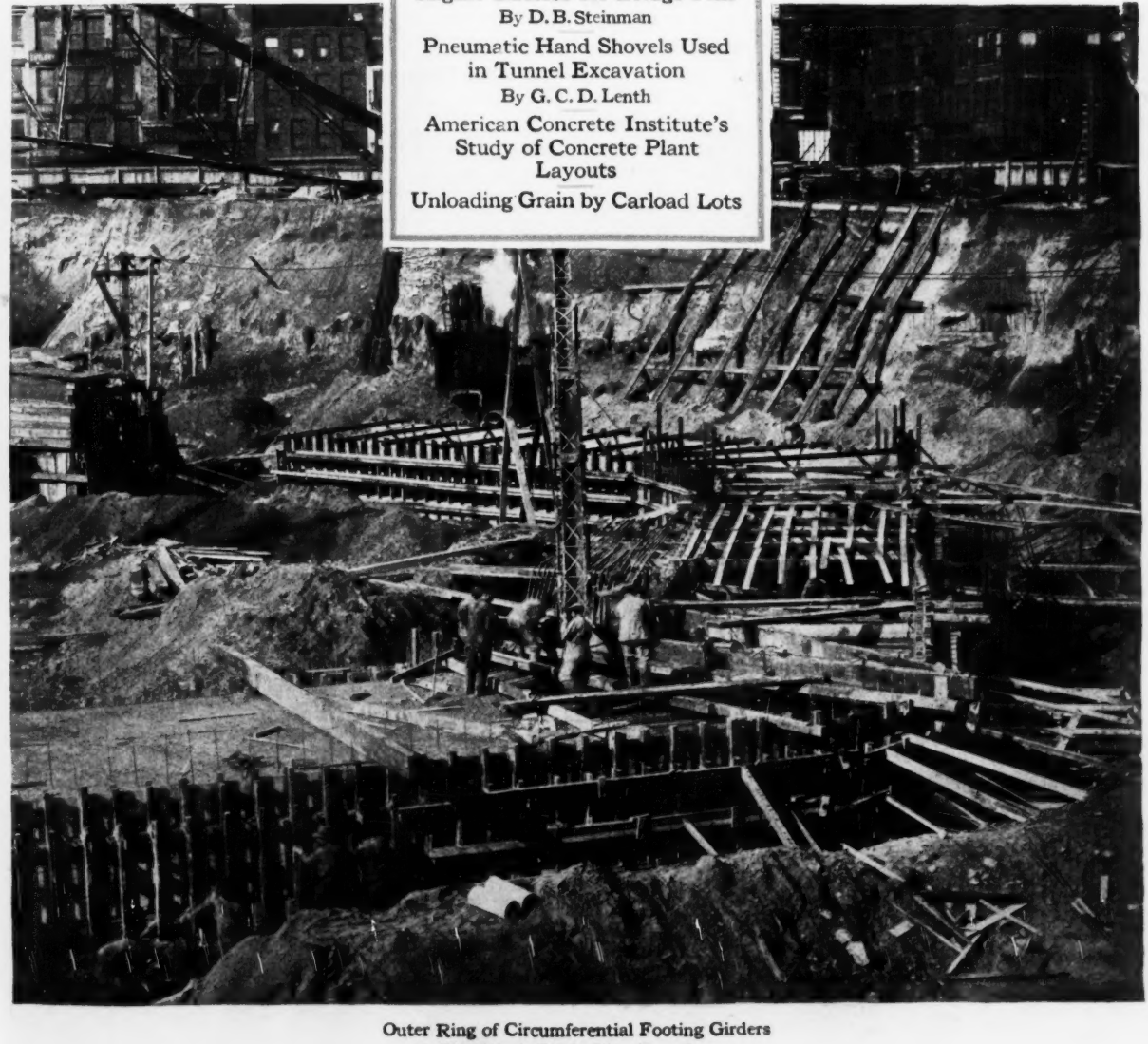
Report of the American Railway Engineering Association Convention

Higher Stresses for Bridge Pins
By D. B. Steinman

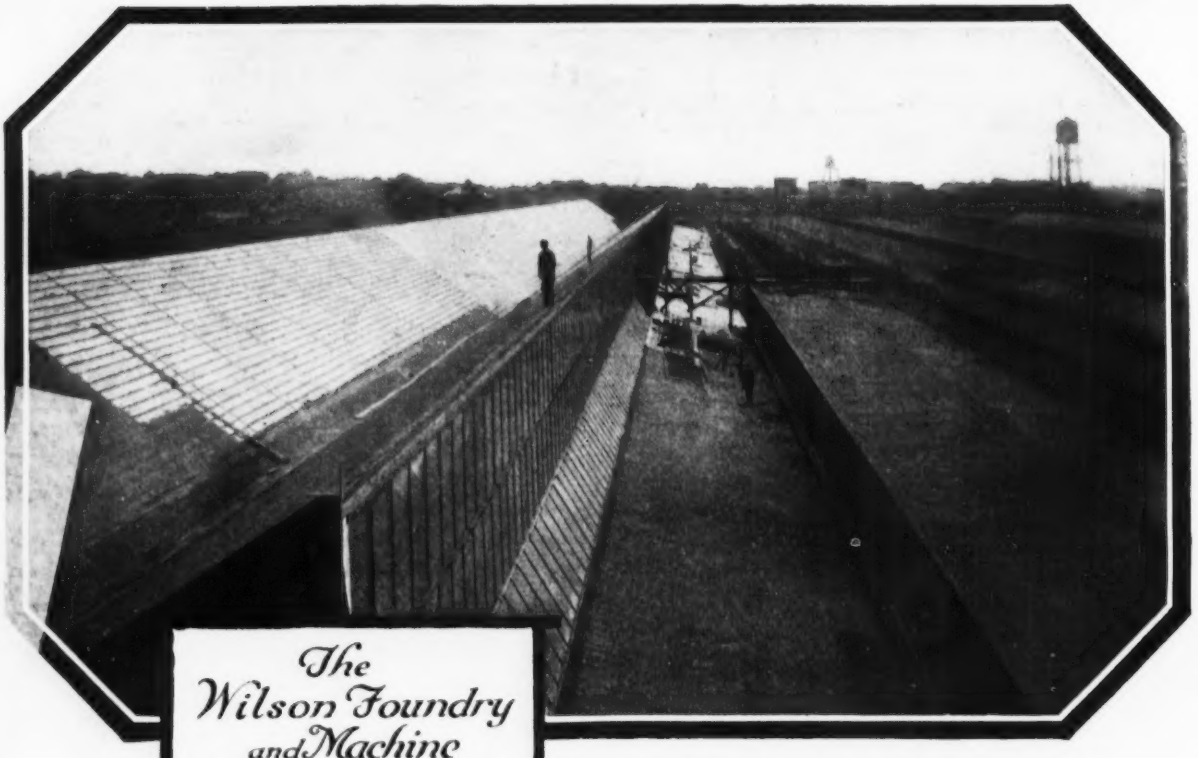
Pneumatic Hand Shovels Used in Tunnel Excavation
By G. C. D. Lenth

American Concrete Institute's Study of Concrete Plant Layouts

Unloading Grain by Carload Lots



Outer Ring of Circumferential Footing Girders in New York City's New Courthouse



The Wilson Foundry and Machine Company's Plant at Pontiac, Michigan.

roofed with

FEDERAL

CHANNEL TILE

Chosen because of:

Economies to be effected.

Permanent protection afforded.

Service of specialists rendered.

Satisfaction derived by thousands of other users.

Guarantee furnished with every Federal Roof.

Our many years' Experience is your Roof Insurance

"The Indestructible Roof"

FOR FLAT and PITCHED SURFACES

Made, Laid and Guaranteed by

FEDERAL CEMENT TILE COMPANY

110 S. DEARBORN ST.

CHICAGO

HAMMOND, INDIANA. —— Works —— DETROIT, MICHIGAN

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 86 — NEW YORK, THURSDAY, MARCH 24, 1921 — Number 12

Studying Concrete Plant

THE report of the committee on contractors' plant of the American Concrete Institute, abstracted on another page, is a real step forward both in the business of contracting and in the art of making concrete. Everyone knows how contracting has progressed from the old days of haphazard planning based purely on experience, but the scientific balancing of available plant layouts suggested by the report is plain evidence of the business-like conduct of a modern contracting operation, especially as the report is not the work of a group of theorists but of practical contractors representative of the best in the concrete industry. The report shows, too, that the mixing and placing of concrete is not an established art in which nothing can be learned, but that side by side with the current studies of how to make concrete better are going equally scientific studies of how to make it cheaper.

To the Credit of Engineers

REORGANIZATION of the Government departments at Washington is evidently going to be one of the first orders of business of the new administration. The President has several times advocated it, only last week Secretary of War Weeks said it was the essential preliminary to fiscal stability and Secretary of Commerce Hoover is probably the leading proponent of the idea of departmental reform. If something is done, whether it be a complete realignment of offices and functions or merely the establishment of a Department of Public Works, it will be a point scored for the engineering profession in its effort to prove to the world that it is entitled to have more say in the conduct of the world's affairs. For many years publicists and politicians have seen the waste in the conduct of governmental business and have periodically urged reform, but their efforts were sporadic and easily discouraged. The engineers, on the other hand, were organized and resourceful, with a propaganda backed up by scientific facts. Unquestionably their campaign, favored by the critical financial situation, has forced official recognition of the inefficiencies of Washington.

Machines vs. Manual Labor

A STRIKING example of the substitution of machinery for manual labor is afforded by the grain-car dumping equipment installed by the Pennsylvania R.R. at Baltimore and described in this issue. It is reported that the device has made it possible to eliminate sixty-eight men. This example is unusual only in that the new machine is so large and of such striking design. In all lines engineers are daily following out what the Pennsylvania has so well done at Baltimore—substituting mechanical for human power. But it is only when there is some dramatic step that we recall the developments over a considerable period and realize how rapid the progress has actually been. In construction machinery, for example, we need cite only the development of paving mixers, of sub-graders, of concrete road finishers, of back-fillers and wagon-loading elevators to indicate where we stand today compared to ten years ago. And the end is not yet. With growing scarcity and cost of labor (considering only natural developments and neglecting the war disturbance) this constant increase of mechanical power devices must continue. The possibilities have not yet been exhausted.

Stimulating Self-Analysis

THE REACTION of the industries chosen to be surveyed by the Committee on the Elimination of Waste in Industry promises that the committee's work will result in a reawakening of our industrial leaders to the need of searching analysis of their operations. We had such an awakening of interest approximately ten years ago when the scientific management movement came into prominence. For various reasons that movement has been largely discredited among manufacturers. That its thesis was sound no one will deny; the methods in many cases, and particularly the alleged management specialists, may have been open to criticism. There is reason for hope that the prejudice may in large part be wiped out through the waste survey now in progress. Manufacturers have repeatedly said that they themselves need to know the things about which the committee is inquiring, and which can be learned from analysis of available data. If this sort of self-analysis can be encouraged throughout industry the committee, and consequently the Federated American Engineering Societies, will have made an important contribution to American economic life.

Harbor Terminal Design

THERE is growing recognition of the importance of better harbor terminals to maintain our place in world trade. The normal times that are coming will not see ships tied up for weeks waiting for cargoes. Other things equal, they will go where the best facilities exist for most economical discharge and loading and quickest turn-around. Here, then, the design of the harbor terminal—not only piers and handling equipment, but also railroad layout—plays an important rôle. For heavy tonnage and fast movement the water-front plan is helpless without the land facilities. Track layout, combined with any necessary warehousing, must be adequate for railroad switching operation and storage. If not the whole operation is slowed up. Although this is an obvious truth, lack of co-ordinating land and waterfront facilities has too often been manifest; the pier engineer and the railroad engineer have designed plants without effective liaison, or either the one or the other has designed the whole layout. Without such liaison, or without a directing designer equally familiar

with rail and ship operation, there is always the likelihood of inadequacy in some respect. The plant as a whole must be considered as a freight-handling and transportation machine. Design must be based upon necessities both of rail and of ship operation.

Filtration of Great Lakes' Water

ONE by one the large cities on the Great Lakes are falling into line for water filtration. Cleveland led the way. Its plant has been in use for some time. Detroit is at work on a filtration project. Milwaukee is in what it is hoped will prove to be only a temporary state of hesitancy and debate. A report recommending water filtration for Buffalo is noted in our news section this week. Most of the smaller cities taking water from the Great Lakes adopted filtration before the larger ones did so. Chicago, largest of all the lake cities, stands alone in having made no definite move for filtration. It still depends upon its sewage diverting drainage canal, its long intake tunnels, and chlorination for water safety. Buffalo, with local conditions pointing strongly toward filtration both for safety and general cleanliness of its water supply, has only chlorination as a defence against pollution. Now that Buffalo is reducing its enormous water waste it is in position to build filters without much if any increase in water rates. Even if a material increase in rates would be required Buffalo should have filtered water.

Concrete Road Reinforcement

CONCRETE road reinforcement design is notoriously indeterminate. For years it has been suggested and used as a remedy for the obvious ills of settlement and cracking but analysis of stresses, with consequent accuracy of location and of size, has been lacking. The road as a structure is now receiving the studious attention it deserves but so far research has not offered any definite solution of this reinforcement problem. Meanwhile, the new design for Illinois, made by Clifford Older and outlined on another page, has a rational qualitative, if not quantitative, basis. There is no attempt made to resist cracking but merely to localize it longitudinally, and the rôle of the novel bondless reinforcement along the road edge is merely to prevent vertical movement once cracking has occurred. The danger in a crack being manifestly in the vertical movement of its edge pieces, the idea thus put into the design is promising.

Pavement Design in Illinois

FOLLOWING his statement of principles in *Engineering News-Record*, May 8, 1919, p. 905, and Feb. 3, 1921, p. 210, Clifford Older, state highway engineer of Illinois, in presenting the slab construction noted in the preceding paragraph, rounds out for the moment the record of a notable effort to produce a logically designed rigid pavement. This process of developing the new slab structure deserves especial recognition now when highway engineering thought is turning to research and analysis for a determination of the proper basis for paved road design. Emphasis on the paved road as a problem in design has been notable in Illinois practice. At the beginning this led more particularly to refinement of construction details. Lacking, because of the advent of the motor truck, even approximate knowledge of traffic stresses and wholly without definite information of foundation soil behavior, the only possible engineering means of safeguarding paved road surfaces appeared to be a heavy slab fabricated with care to develop the strength of the material. Further improvement, it was quite as plain to the engineers of the department, required facts regarding subgrade and traffic action on the pavement slab. It has been by its labors to determine these facts that the state highway engineering department in Illinois has established a claim to leadership in pavement design. True appraisal of the pavement design described has seemed to demand the background which has been sketched. This design is admittedly tentative; a tentative design is all that is possible with the present knowledge of paved road behavior. It is, however, true design as this term is understood by engineers, and not the product of trial and failure as have been all pavement slabs hitherto laid down. To this degree at least the development is unique in the actual practice of paved road building.

Ultimate Strength and Pin Stress

WHEN very high strength is displayed by a material or type of member it becomes pertinent to consider whether this strength may safely be utilized. So in the case of the remarkable test values for bridge pins, brought to attention anew by the review on page 502 of this issue. Under former practices in fixing stresses —by referring them to ultimate strength, and applying a factor of safety, as three, or five—there would be no doubt that high test strength would be reflected in high working stresses. But the view held in recent years is that safety should be rated on elastic-limit strength, chiefly because this latter is very often the effective ultimate strength in service. Not only are many structures of such constitution that general failure supervenes when any one element begins to yield, but the general liability of structural metal to sudden fracture due to brittleness, local injury or other interference with plastic distortion has the effect of wiping out the difference between ultimate and elastic strength so far as use is concerned. Pins, however, are outside the scope of these considerations. Unlike all other structural members they appear to be immune against premature fracture. Further, when a pin becomes unserviceable, through either bending or grooving, it does not at once endanger the structure. In sum, pins can be counted on to stay in place and hold the structure together up to ultimate testing-machine load. This lends increased meaning to the high test figures, since they may be interpreted in conformity with old-time practice as the direct gage of working stresses.

How Shall Engineering Practice Be Limited?

MUCH attention is being given in New York State to the proposal to repeal the clause in the engineers' licensing law allowing corporations and partnerships to practice engineering. The question having been raised, it is quite likely that the issue will be made a national one. If so it will have to be opened up in the American Engineering Council, for the New York clause it is proposed to repeal is in accord with the former Engineering Council's model licensing bill. In other words, the council's bill would permit corporations and partnerships to practice engineering provided the engineering work done by the corporation or partnership be under the direction of licensed engineers. In neither

case is the corporation or partnership itself licensed, though that, practically, is the effect of the provision. It is to be noted that those who want the corporations and partnerships excluded from practice are careful to use the term "unrestricted partnership." The term is not clarified in the petition (see page 518), but is explained by those responsible for it to mean partnerships in which non-engineers may be members. They do not object to practice by partnerships in which every member is a licensed engineer. Obviously, this is a logical position, for it restricts the practice of engineering to those who have the proper qualifications. This point not having been brought out strongly in the petition against corporate and partnership practice has not received attention from the opposing side. In the course of future argument, however, this qualification of the type of partnership should be given consideration.

Again, we reiterate the importance of the question. It should have immediate, thoughtful and widespread discussion.

Government's Report on California's Highways

SOME months ago a report was made to two of the large California automobile clubs regarding the condition of the California highway system. This report had a critical air, a fact brought out in our comment thereon in the issue of Feb. 10. Later the California Highway Commission itself made reply to the criticisms, and now we have what may be considered the final evidence in the case—a report by the U. S. Bureau of Public Roads.

The latter report, made by Dr. L. I. Hewes, the bureau's general inspector for the West, was abstracted in the *Engineering News-Record* last week, p. 469. That brief abstract will give the experienced highway engineer confidence in the report, for ever the abstract bears evidence of a full grasp of the subject, of remarkable thoroughness, and of impartiality. But the abstract does not do the report justice. It is a remarkable document. Nothing like it has ever been written before, a fact that will come home to engineers when the printed copies are available. It breaks new paths in several directions, and will, we believe, be the groundwork on which investigation of a similar sort will be based for many a day.

With that in mind it is worth while examining the conclusions. The clinching fact is in this finding: that of a total of 1,262 miles of concrete pavement 87.5 per cent is in Class A, B or C condition (which may be described as good or better than good), while only 12.5 per cent is in the inferior classes, D, E and F. This rating is on a *definite quantitative basis*. When it is remembered that this concrete pavement is practically all 4 in. thick, that the use of this thin slab has made it possible to give a large part of the state good highway service, and that the design was determined nearly ten years ago, before the heavy traffic came, there can be no other conclusion than that, measured by results, the California Commission's work has been a success. The bureau's report does not agree with all the commission's policies; in fact it suggests many changes, but back of the results above quoted it is not possible to go. The bureau's view is well summed up in this paragraph of the report:

"It cannot be said in 1920, in the light of the fact that the great usefulness of the highway system is now proved, that the state would have realized its usefulness and provided funds in equal volume had not the system been extended as rapidly as it was and at some sacrifice of either temporary or ultimate durability to increase mileage. There appears, however, to be serious question, in the light of the fact that 70 per cent of the defective pavement of classes D, E and F occur on clay and adobe soils, as to the wisdom of the policy which continued the risk of a thin slab on such soils. It is undeniable, however, that a large mileage of the same thin pavement on adverse soil still remains of classes A, B and C. We find, however, no conclusive final demonstration of the best construction on the adverse soils, and in that respect failure to vary the designs on such soils in the past has postponed the solution of this problem."

As was to be expected, it was found that all was not perfect in the commission's management, that some things should have been done which were not done, and some things should have been done differently, but when all is cast in the scales, the good in the one pan and the shortcomings and mistakes in the other, the result is such as to demand the highest praise for the commission's work.

The critics of some months ago will, indeed, find corroboration in part of the paragraph above quoted and in many other phases of the report, but their lack of sympathetic understanding, to which attention has already been called, stands out all the more clearly by comparison with the temper of the new report.

It was to be expected that the bureau would find the 4-in. slab inadequate (the commission itself has abandoned it in favor of a 5-in. reinforced-concrete design). It advises experimental sections on the unfavorable soils, suggesting that designs of not less than 6 in. in average depth, reinforced, will be necessary in view of the weight of traffic. It states that the famous California 2-in. carpet coat does not give a service commensurate with its cost, a view largely held by highway engineers outside of California, and urges studies of traffic, fatigue of concrete, soils, and alkali. Finally, there is this important judgment on the California lesson with reference to concrete roads:

"There is nothing presented by the entire California study that indicates that concrete is not a successful pavement."

Only one of the features of the report which breaks new paths in highway study will be mentioned here: the simple, but satisfactory, method developed for classifying the condition of concrete roads. The other path-breaking methods will be discussed in early issues.

Heretofore we have had the qualitative gradings of "excellent, good, fair, poor," with their many variations. Quantitative descriptions seemed impossible. Yet the impossible has been done. The classifications worked out by Dr. Hewes are reasonable, simple and definite. As to the major features which make or mar the value of a concrete pavement, no ground is left for judgment. Such things as pitting and unevenness of original finish are excluded, but these exclusions are of minor importance compared to the covering of the principal features.

If the report, aside from its local significance, had produced nothing but this classification it would properly have merited special commendation.

Foundation of Multiple Concrete Ring Girders For New York Court House

Prevention of Unequal Settlement the Controlling Problem in Supporting Heavy Monumental Building of Hexagonal Ground Plan on Sand

By Carlton S. Proctor
Of Moran, Maurice & Proctor, Consulting Engineers, New York City

IN PLANNING the new court house for New York County at Worth and Centre Sts., New York City, Guy Lowell, the architect, found himself confronted by a most unusual foundation problem. Study of this problem by the firm of which the writer is a member led to a foundation design departing sharply from precedent. It is believed that the special requirements which contemplated a circular building 400 ft. in diameter, of highly ornamental character. Above ground the proposed structure consisted of a steel-frame masonry building forming in effect six concentric rings, each comprising a series of columns and walls.

Located on an irregular site between Centre, Worth, Baxter and Pearl Sts., the building occupied a portion

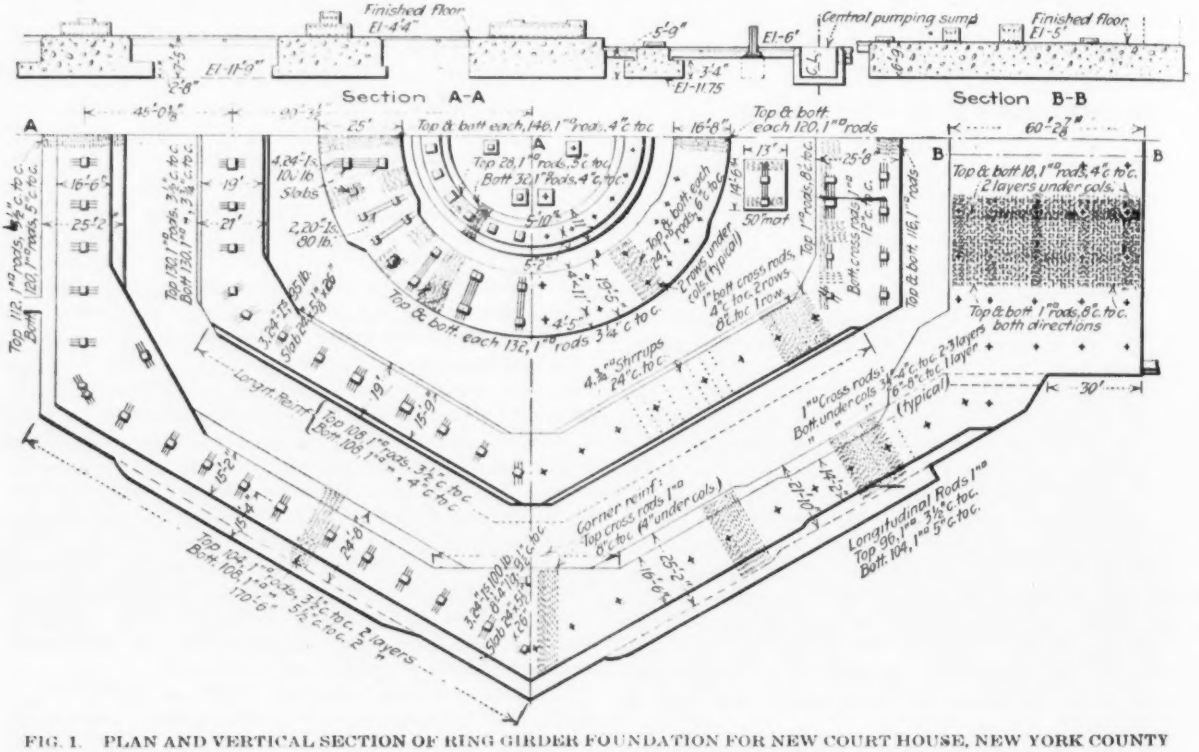

Finished Floor El-4'4"
Central pumping sump
Finished floor El-5'
Section A-A
Section B-B
Top & bott each 146, 1" rods, 4" c to c
Top & bott each 120, 1" rods
Top 28, 1" rods, 3" c to c
Batt 32, 1" rods, 4" c to c
Top & bott each 132, 1" rods 3¼" c to c
Top & bott 116, 1" rods
Top & bott 18, 1" rods, 4" c to c, 2 layers under cols.
Top & bott 1" rods, 8" c to c, both directions
1" cross rods, Bott. under cols 4" c to c, 2 layers (typical)
Longitudinal Rods 1"
Top 96, 1" 3½" c to c
Batt 104, 1" 5" c to c

FIG. 1. PLAN AND VERTICAL SECTION OF RING GIRDER FOUNDATION FOR NEW COURT HOUSE, NEW YORK COUNTY

of the case, due to the nature of the building and to the ground conditions, are fully met by this type of foundation. It consists of a series of ring girders, each supporting a ring of columns (in one case two parallel rings of columns), and capable of equalizing any tendencies toward irregularity of settlement.

Sand subsoil is found at the site of the court house, to great depth, and it was necessary to support the building on this sand. Because of the nature of the building, it is of large ground plan area. Differences of settlement are therefore a possibility that must be considered, while on the other hand the monumental character of the structure made it imperative to prevent settlement of a kind that might result in cracking of the structure. Groundwater conditions also affected the design, as will appear.

In 1914, after a competition for designs, the Court House Board accepted plans submitted by Mr. Lowell, of the old Collect Pond, shown on early city maps. Under the circumstances it was evident to the architect and to the engineers called in to advise him that unusual precautions should be taken to provide a foundation insuring the least possible inequality of settlement.

Exploration of the site by borings was conducted in 1914. Seven pipe borings were taken by a method furnishing dry samples; nineteen wash borings were made, and seven test pits were sunk. The results showed that rock occurred in a few places at a depth in the vicinity of 150 ft., but over most of the site was below 210 ft., the limit of the exploration; that the surface material was artificial fill, including at one point the refuse of a tannery, overlying a deposit of fine sand, clay, silt and peat; but that about 33 ft. below curb, or El. —15, sand, or gravel was encountered over the entire area. The borings indicated that this

sand and gravel deposit was continuous and extended down to the limit of the borings.

It was evident that the building would have to be founded in this sand and gravel stratum and that a thoroughly substantial foundation was afforded by it, but that this foundation would inevitably be of somewhat compressible character, when considered in relation to the high demands for prevention of differential settlement of the building.

At this time the depth of water in the soil was 14.5 ft. below mean high water (the latter being datum). Groundwater at the present time is at El. +2. The former low level of the water undoubtedly was caused by long-continued pumping for construction of the Canal St. subway station, two blocks to the north.

Loading tests were made on the sand and gravel subsoil in the exploratory test pits. These confirmed the engineers in their opinion that the material would support the building safely.

Since the very great depth to rock made a rock foundation impossible, and at the same time the character of the material was such as to eliminate consideration of piles, it was evident that spread footings of some form had to be adopted. In view of the monumental and spread-out character of the building, careful consideration had to be given to the question of differential settlement. It was obvious, of course, that the footings should be carried down to the sand or gravel, and not rest in the artificial fill or the silt and mixed strata overlying the sand; but as the material did not vary in character below El. —15, it did not appear that there would be any advantage in going deeper. The importance and monumental character of the building also made it advisable to limit the foundation loading to very moderate values.

FIG. 2. NEW COURT-HOUSE SITE EXCAVATED TO LEVEL OF BOTTOM OF GIRDERS

It was concluded that isolated footings for the various columns would be almost certain to settle non-uniformly. The material is variable in texture, and this, together with the inevitable differences in the physical condition of the underlying strata, would make even the most careful proportioning of the footing area an insufficient precaution against differences of settlement. The variation in live-loads was a further unfavorable factor. It was concluded that either some arrangement of combined footings or an integral foundation should be used. Grouping a number of adjacent column footings into a single foundation did not appear to allow sufficiently for the probable variations in foundation resistance over the site. A full mat foundation over the whole area, on the other hand, threatened to be of prohibitive cost, the more so as the indeterminate distribution of stresses would require the mat to be made thick enough to give an ample margin of safety. Two special arrangements of combined footings were therefore discussed, each being of a kind to average the physical conditions over a large area. In the one, a radial line of columns would have a common grillage or girder foundation; in the other these girders would be circumferential, or ring shaped, carrying one of the column circles in the framing of the building.

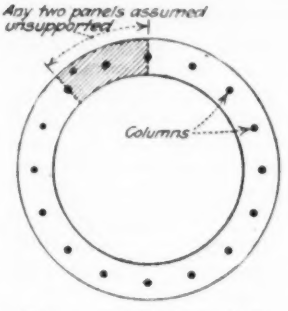


FIG. 3. EXTREME LOAD ASSUMPTION

As the architectural arrangement of the building was such that the walls and principal partitions ran circumferentially, radial equalization of settlement would be of little effect, whereas circumferential equalization by means of circular foundation girders would safeguard against cracking of walls and would leave no opportunity for harmful differential settlement except that which might occur between consecutive rings of columns, where it could affect at the worst some minor partitions. This circular girder scheme was therefore adopted.

It was not possible nor was it considered necessary to make the circular girders strong enough to carry the load under the extreme condition of support concentrated at two opposite points of the ring. Each girder was designed to transmit the entire load of any one column to the remaining part of that girder, on the assumption (Fig. 3) that the soil under the adjoining two panels had no supporting value. This simple assumption was found to represent a more severe requirement than various other possible inequalities of load distribution.

After a complete design had been made on this basis, a change in policy of the city government resulted not only in temporary suspension of work on the plans but in a subsequent complete modification of the build-

ing project. In the fall of 1919 the architect was authorized to proceed on the basis of a revised plan, the revision providing for a building of hexagonal shape and only about 80 per cent as large in plan as the original circular building. The changes naturally called for complete redesign of the foundations, but the same general scheme was used. As will be seen from the plan in Fig. 1, one of the circular girders carries two adjoining circles of columns, while in the earlier project two girders were used here. The foundation is now under construction and is nearly completed. Rodgers & Hagerty, Inc., are the contractors.

In the final planning two comparative designs were worked out for the circular girders, as sketched in Fig. 4. One was of the type contemplated in the earlier planning, comprising a relatively thin concrete base slab and circular steel distributing girders resting on this slab. The other combined the slab and girder functions in a reinforced-concrete T-girder, in which the bearing-slab action was taken care of by the head of the T. The reinforced-concrete girder proved to be more economical as well as more adaptable and flexible in application to the varying conditions of the design, and it was therefore adopted.

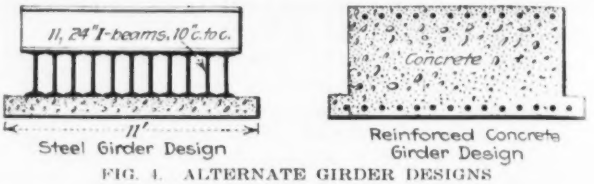


FIG. 4. ALTERNATE GIRDER DESIGNS

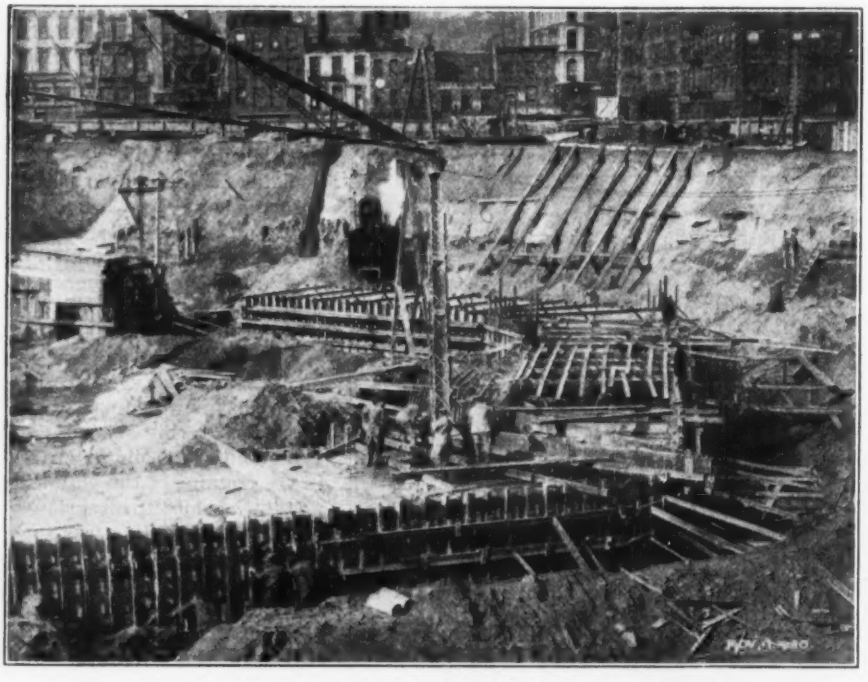


FIG. 5. CONCRETING ONE OF THE FOUNDATION GIRDERS

Uniformity of loading on the soil was obtained by varying the width of the girder base, or head of the T, while the unit stresses in steel and concrete were adjusted by varying the thickness of the stem of the T and the amount of reinforcing.

As designed, all portions of the foundation are subjected to a load of 2 tons per square foot of soil bearing area, under dead load. The proportions being adjusted for uniformity in this way, the design was checked for dead plus probable live-load; the base pressure in this condition does not exceed 3 tons per square foot at the points of highest live-loading.

In the execution of the design care was taken to insure that construction joints separating successive days' work—as it was impossible to cast each ring in a continuous operation—should not establish dangerous shear planes. To this end the construction joints were placed at the points of "minimum average" shear, or halfway between two of the lighter columns, and each joint was formed in a step, so as to give a lap or halved joint between the successive pourings.

In the original design, subgrade was at El. —15. The final design, however, took advantage of modifications made by the architect in the revised plan, and also of the fact that due to a slight change in the location of the building 92 per cent of the area of the footings would encounter the sand and gravel at a higher elevation, namely —11.75. Placing the elevation of bottom of girders at the latter level saved approximately 11,000 cu.yd. of excavation and a very considerable amount of concrete. It also greatly simplified the drainage problem, both during construction and during the life of the building. Under the portico on the Centre St. front, where the top surface of the sand and gravel bed is below El. —11.75, the excavation will be carried slightly deeper, as may be necessary to reach good material.

After the letting of the contract it developed that the groundwater level had risen from El. —14.5 to El. +2, as already mentioned. This was not entirely unexpected, as there was at this time no deep construction in the vicinity and consequently no pumping which would maintain groundwater at an unnaturally low level. A large part of the excavation, therefore, had to be made through water-bearing material. The contractor dealt with this difficulty by establishing a central sump, and reducing the water level as the excavation progressed; by the time footing level had been reached, the groundwater was drawn down sufficiently below this level to permit the casting of all the footings on undisturbed dry material. These means, while simple, were entirely effective in preventing any disturbance of the foundation bed by the large amount of water entering the excavation.

In general the excavation was carried down to a level approximating subgrade over the entire area. In the main part of the work, while the groundwater was being drawn down gradually, between 3,000,000 and 5,000,000 gal. of water per day were handled. When

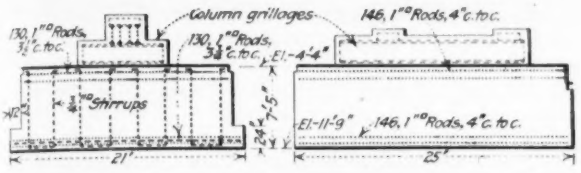


FIG. 6. CROSS-SECTIONS OF SINGLE AND DOUBLE COLUMN RING GIRDERS

the excavation had approached subgrade in any portion of the site, drains were placed below subgrade for collecting the water and preventing its flow upward through the floor into the excavation, thereby preventing the formation of springs and the disturbance of material by water action. In this manner an excavation 2¼ acres in area was carried 30 ft. below curb level and 14 ft. below groundwater level (Fig. 2) through material generally considered unfavorable for such work, and a bed of sand was utilized for the support of the building without permitting any disturbance of its natural compact character.

It should be said, however, that the design would not have been based on the execution of the work in this manner (in open excavation), had it not been that recent experience demonstrated the practicability of reducing the water level in the subsoil by proper drainage and pumping. The fact that the water level at this site had in 1914 been reduced over 15 ft. by adjacent pumping operations made it certain in advance that thorough drainage of the soil in construction was feasible.

In the revised design of 1919 the sub-basement floor was planned to finish at El. —4.33, and provision was made for a complete subsoil drainage system with Hydrolithic waterproofing on all exterior walls and the sub-basement floor. As the excavation progressed, it was found that the material at subgrade at the eastern end of the side was largely composed of gravel, which, while an excellent material for the support of the building, permitted the flow of a considerable amount of water. In view of these conditions and in order to save the city the cost of pumping during the life of the building, the substitution of a pressure-resisting floor for the simple concrete pavement over the spaces between the girder rings was recommended.

The history of the court house to date has been one of changes and delays, and at the present time all contracts except the foundation contract have been cancelled by the city authorities. The foundation work is to a large extent completed. The size of the work can be judged by the following approximate table of quantities involved: Area of excavation, 2¼ acres; volume of excavation, including an unknown amount of ash fill, 93,200 cu.yd.; concrete in footings, retaining walls, floor, etc., 19,970 cu.yd.; reinforcing steel, 1,450 tons.

Population of Japan and Its Cities

The first census of Japan, recently completed, shows a population of 55,961,140 for Japan proper, 17,284,207 for Korea, 3,654,000 for Formosa and 105,765 for Saghalien, or a total of 77,005,112, according to a Washington dispatch to the New York *Times*. The larger cities have populations as follows: Tokio, 2,173,-162; Osaka, 1,252,972; Kobe, 608,268; Kioto, 591,305; Nagoya, 429,990; Yokohama, 422,942. Eight other cities have more than 100,000 inhabitants each.

Railway Ballast and Ballasting Methods

Abstract of report of Committee on Ballast, American Railway Engineering Association.

ON ROADBED MATERIAL subject to deformation under live load, the proper depth of ballast under the ties to produce approximately uniform pressure on the roadbed would be not less than the spacing of ties center to center. On material like good sub-ballast, which will not be deformed under live load, the minimum depth of ballast under the ties should be 12 in. These depths are required to give good drainage, to prevent heaving by frost and to form a cushion for the track. A combination of 18 to 14 in. of good sub-ballast and 6 to 10 in. of top ballast, making a total depth of approximately 24 in. under the ties, will produce nearly the same result as an equal depth of the superior material.

Stone ballast should be of such size that the pieces, in any position, will pass through a 2½-in. ring and not through a ¾-in. ring. Bank gravel for first class track should be washed and screened if it contains more than 2 per cent dust or 40 per cent sand; for second class track these proportions would be 3 and 60 per cent respectively. Screened gravel should contain not less than 25 per cent or more than 50 per cent of sand. Stone ballast should be cleaned at intervals of 1 to 3 years in terminals, 3 to 5 years on heavy traffic lines and 5 to 8 years on light traffic lines. From 15 to 25 per cent of new ballast will be required to maintain the standard section.

Hopper cars with a ballast plow or tie drag should be used in distributing ballast for raising track, but for ballasting a parallel track, side dump cars are preferable, especially when operated by air. Convertible cars having sides which swing out and upward, when used with the side plow and unloader engine, are fairly satisfactory when dump cars are not available. Anchoring the train and pulling the plow through it by a cable attached to the locomotive is a poor substitute for the unloader engine, but it is better than unloading by hand. With the spreader car, especially when operated by air, ballast deposited alongside the running track for a new second track can be spread to the outside shoulder and to a grade 2 in. below bottom of ties at a speed of 8 m.p.h. On a grading dump, in wet clay or rock, the spreader will do the work of fifty men and still be idle most of the time.

Ventilation Tests for Vehicle Tunnel

Investigations of ventilation for the Hudson River vehicular tunnel, as announced in the news section of this journal March 4, are being conducted under a co-operative arrangement between the U. S. Bureau of Mines and the New York-New Jersey Bridge and Tunnel Commissions. Flow of air in ducts and bends, such as will be used in the tunnel, is to be tested at the University of Illinois, where the Bureau of Mines has its central district experiment station. An experimental duct 300 ft. long is being constructed at Urbana and special 300-hp. motors and fans are being installed. The final check on the solution of the ventilation problems will be obtained in an experimental tunnel that is now being constructed in the experimental mine of the Bureau of Mines at Bruceton, Pa., just outside of Pittsburgh. An oval-shaped tunnel having similar construction of ducts to those proposed in the Hudson River tunnel and an axel length of 400 ft. is being constructed underground. The cross-section is large enough to carry a single line of automobiles. Studies will be made with respect to the following features: (a) Diffusion of exhaust gases in the cross-section of the tunnel; (b) temperature conditions as affected by the operation of internal-combustion motors; (c) physiological effects of temperature, exhaust gases, and smoke under operating conditions; (d) final check on all previous investigations.

Road Guard Rail Timbers Mounted on Concrete Pipe

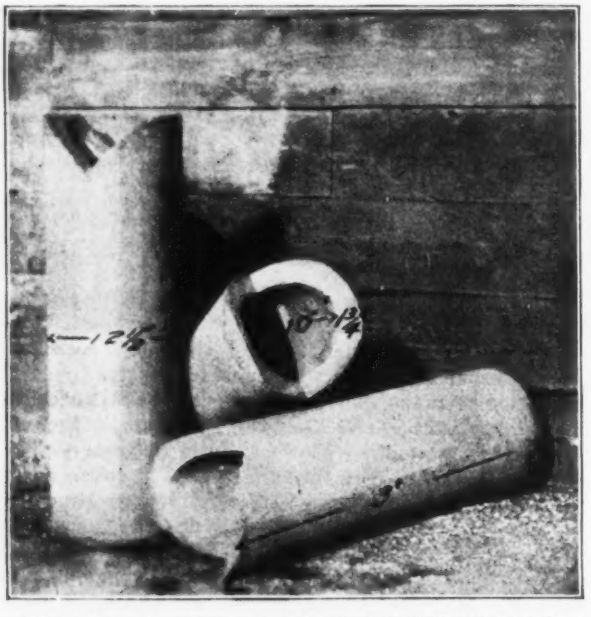
System Adopted for Highways at Spokane, Wash., Is Cheap, Strong, Readily Visible and Safe

By A. D. Butler
City Engineer, Spokane, Wash.

IN THESE days when there is an ever increasing number of automobile accidents, the engineer who has to do with the construction of highways, streets or boulevards, every year finds it more necessary to protect the edges of his fills or side-hill work by a suitable guard rail, one which is required to render an entirely different service from the guard rail or handrail of several years ago.

What is the problem of design in such rails? First there is the matter of cost. They must be as cheaply constructed as possible. And in the matter of first cost can be considered the length of time before they must be removed; or, in other words, the cost per year.

Second, the rail must be strong. While it is impracticable to build a structure that will withstand the shock of a heavy automobile driven at a high rate of speed, or that of a heavy truck, yet it should be strong enough so that after it has been run into by an automobile driven at a reckless rate, the repair man can come out



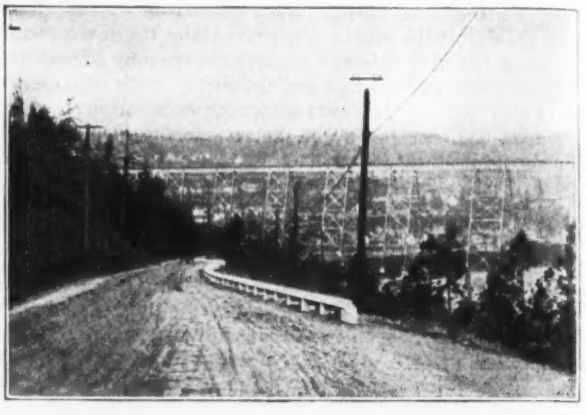
CONCRETE PIPE USED AS STANDARDS FOR GUARD RAIL

and haul off the remains of the machine, rather than send for the maintenance crew to repair the guard rail.

Third, it must be borne in mind that, in the vast majority of cases the machine that collides with the rail will do so almost parallel to the direction in which the rail is running; so, if possible, a rail should be used of such height as to have the tendency, when collided with in this manner, to permit the wheel to slide along it and crowd the machine back into the road, rather than to have any projecting posts to catch the wheel or hub and thus wreck the machine or destroy the guard rail.

The fourth requirement is that the rail should b readily seen both in the daytime and at night. Wit these fundamental requirements in mind, the writer ha adopted the following form of guard rail with consider able success.

The posts consist of machine-made concrete pip made by the Spokane Concrete Pipe Co. with a Ham mond machine. These pipe are 3 ft. long and 10 in. i diameter. A V-shaped templet is used in the botto of the mold, such that when the pipe is made, an 8 x 8-in



GUARD RAIL IN PLACE ON ROAD IN SPOKANE

timber will fit corner wise in this V-shaped notch. These pipes are then filled with concrete and a bolt anchored in the center of the V, extending outward far enough to pass through an 8 x 8-in. timber corner-wise. The holes for the posts are dug, the posts stood in place and the timbers, after having been bored, are fitted into the V of the posts with the bolt extending diagonally through the timber. The posts are then lined up, filled and tamped around. The rail should be of such a height as to be just below the hub of an automobile wheel. In this way it furnishes the maximum protection to the machine with the least danger of catching the hub and wrecking the auto.

On a recent job, 1,600 ft. of this guard rail, constructed by the Street Department under Leonard Funk, commissioner of public works of Spokane, cost a total of $947.77, including the cost of all material and labor in finishing and painting. This made the rail cost 59c. per ft. The items of cost were as follows:

1,600 lin.ft. 8x8-in. timber	$361.12
202 posts	303.00
Cement	20.90
Paint	16.58
Washers	3.10
Paint brushes	6.17
Bolts	34.00
Labor	202.90

The following formula for whitewash has been used and gives very good satisfaction:

Half a bushel of unslacked lime; slack with warm water; cover it during the process to keep the steam; strain the liquid through a fine sieve or strainer; add a peck of salt previously dissolved in warm water; 3 lb. of ground rice, boiled to a thin paste and stir in boiling hot; ½ lb. of Spanish whiting and a pound of glue which has been previously dissolved over a slow fire, and add 5 gal. of hot water to the mixture; stir well and let stand for a few days; cover up from dirt. It should be put on hot. One pint of the mixture properly applied will cover a square yard. Small brushes are best.

Comprehensive Report on Water Supply of Kansas City

A COMPREHENSIVE report on the water-works situation of Kansas City, Mo., in printed form has now become available. In it are recommended a new intake from the Missouri River on the Platte-Clay County line upstream from the city in the State of Missouri, a low-lift and secondary pumping station and purification works, pressure tunnels to connect with the present Turkey Creek station and a proposed high-lift station on the East Bottoms and a new high-service station on the Nicholson Ave. site above flood levels.

Project Outlined

The project outlined is good for 108 m.g.d. and is estimated to cost $18,000,000 at present unit figures, but the engineering Board of Review considers the matter urgent and urges the city officials to push the matter with all possible haste since it will take seven or eight years to construct the works and by that time the present capacity of the existing works, which cannot easily be extended, will have been reached. The personnel of the board is as follows: Wynkoop Kiersted, chairman; C. S. Burns, George A. Johnson, Alexander Maitland and John Prince. The consulting engineers are Fuller & McClintock, New York City. From their report the following notes are taken:

A population of 700,000 expected in 1943 is to be provided for. This will be twenty years after the bulk of the bonds are dated and the state constitution provides that city bonds must be amortized in 20 years and the present generation ought not to be required to provide for works for a much longer period. In 1943 the average consumption is estimated at 104 m.g.d.; maximum for month, 125 m.g.d.; for week, 135 m.g.d.; for day, 145 m.g.d.; for hour, 178 m.g.d.; and for hour including fire draft, 205 m.g.d. If the water is to be sanitary, clear, free from color, tastes and odors and have a reasonably low hardness, filters must be provided.

The Missouri River proved on investigation the most economical and feasible source. The Ozark supply would require filtration, a 140-mile conduit and three pumping stations with an aggregate lift of 1,100 ft. at a cost exceeding $70,000,000. Well supplies are hard and require removal of iron as well as softening Lakes near St Joseph are insufficient in quantity. To take the Missouri water above St. Joseph involves a 70-mile aqueduct. While avoiding the sewage of Leavenworth, Atchison and St. Joseph it is nearer Omaha and analyses indicate at the lower point inappreciable pollution easily removable by filtration. Storage possibilities on the Kansas River are possible but the quality would be little better than the Missouri and conduits and lands for impounding reservoirs much greater, besides which the works would be subject to heavy taxation by Kansas. The site selected for the intake line within the state will be free from taxation, subject to local police protection and where power of condemnation is available for tunnels.

Utilization of the site of the Quindaro works, which lie in Kansas, for a new plant, involves heavy taxes. When the total annual costs are taken into consideration there is practically no advantage in locating new works at Quindaro in Kansas in order to utilize the existing investment there. The fact that it is not feasible to enlarge the Turkey Creek pumping station, together with the growth of the city to the east and south, makes it advisable to construct a complete new high-lift station in the East Bottoms. In connection with this station a covered equalizing reservoir will be required to balance the hourly peaks and to provide for fire drafts.

Estimated costs are as follows: Intake and protection, $1,013,000; river pumping station, low lift to filters and high duty through pressure tunnels to city, $1,300,000; purification plant comprising grit and reaction chambers preliminary settling basins, coagulating basin, rapid sand filters and filtered water reservoir, $4,485,000; concrete-lined pressure tunnels, 80 to 100 ft. below river and solid rock to river (22,000 ft. 7½ ft. diameter) with branches to Turkey Creek station (12,000 ft. 6½ ft. diameter) and to East Bottoms station (14,000 ft. 6 ft. diameter), $4,471,000; East Bottoms station and 20,000,000-gal. equalizing reservoir, $2,714,000; discharge main from East Bottoms station to distribution system, $2,400,000; distribution system and improvement of existing works, $1,600,000.

Filters, settling basin, pumps and boilers should be built with capacity for about ten years, but in general the works should be designed for needs up to 1943.

Immediate improvements of the existing works recommended are as follows: (1) Shut off sewer flush tanks and restrict street flushing, meter all services and continue plumbing inspections with a view to curtailing waste; (2) exercise vigilant and exacting laboratory control; (3) install a 50-m.g.d. pump at Quindaro station and a 30-m.g.d. unit at Turkey Creek station, (4) add valves to discharge headers at Turkey Creek to minimize the danger of throwing several pumps out of service in case of a break; (5) continue to develop gridiron system; (6) cover Turkey Creek reservoir, Holly St. reservoir and Northeast basin to protect them from contamination.

Basic Data

Basic data on which the five river projects were compared are as follows. Structures readily constructed piecemeal are estimated as of 1933, others for 1943. In 1933 the average daily consumption is estimated at 71 m.g.d. and the maximum, 100 m.g.d. In 1943 corresponding figures are 104 and 145 m.g.d.

The intakes have been planned for the maximum 1943 capacity. Of the low-lift and secondary low-lift pumping stations everything except the pumps and boilers have been planned for 1943 maximum capacity, but the first installation is for 1933 conditions. Force mains are planned for 1933 conditions.

In the purification works grit chambers with hopper bottoms are planned for 10-min. flow of 145 m.g.d.; the reaction chambers for 30 min. flow for 145 m.g.d., baffled to produce a velocity of 1 ft. per minute; of four preliminary settling basins having a combined capacity of 39 m.g., equivalent to 9 hours flow of 104 m.g.d., only three are to be built at first; of four coagulating basins having combined capacity of 52 m.g., equivalent to 12 hours' flow for 943 average conditions, three only are to be built, providing for 1933 conditions; eighteen 4 m.g.d. filters for the initial installation having 40 to 50 per cent overload capacity; head houses for average 1943 conditions with 40 to 50 per cent overload capacity in the application of chemicals; 2.9 m.g. filtered water reservoirs planned for 40-min. flow for average 1943 conditions; connecting conduits, gate houses, aerating devices and pressure tunnels for maximum 1943 capacity.

Aeration is to be effected at times by passing the raw water weirs 3 to 5 ft. above the grit chambers. In its fall into the chambers the water would be broken up by riffle boards.

In proportioning tunnels and conduits the Hazen-Williams formula was used, with $c = 120$ for concrete pipe, tunnels and conduits, $c = 100$ for cast-iron pipe, $c = 90$ for steel pipe.

The main tunnel would be driven 16,000 ft. of its 22,000 ft. without intermediate shafts, but for the smaller branch tunnels temporary shafts at 4,000-ft. intervals would be provided.

Road Types on Lincoln Highway

On the 3,305 miles of road forming the Lincoln Highway between New York and San Francisco the mileage of the different types of construction on Jan. 1, 1921, was as follows: Graded gravel, 956; graded earth, 725.67; concrete, 422.34; bituminous macadam, 401.81; macadam, 287.10; brick, 219.68; natural earth, 136.00; asphalt, 78; natural gravel, 62.10; granite block, 7.10; creosote wood block, 5.90; sand, 3.30.

Pneumatic Hand Shovels Hasten Tunnel Excavation

Shovel Blades Attached to Pneumatic Hammers Cut and Loosen Very Stiff Clay Without Picking or Blasting

By George C. D. Lenth
Consulting Engineer, Chicago, Ill.

PHENOMENAL progress in tunneling stiff clay has been made by using pneumatic shovels, in constructing a large sewage conduit in the south part of Chicago. In round figures, a foot an hour of completed tunnel is being averaged. This exceeds any local record and Chicago has built some scores of miles of clay tunnel in the last 25 years.

A three-barreled conduit had to be constructed, extending from the Calumet pumping station of the Sanitary District of Chicago, located near 125th St. and Indiana Ave., to the site of the proposed Calumet sewage treatment works now under contract, located just north of 125th St. and east of the right of way of the Chicago & Western Indiana R.R., a distance of 2,300

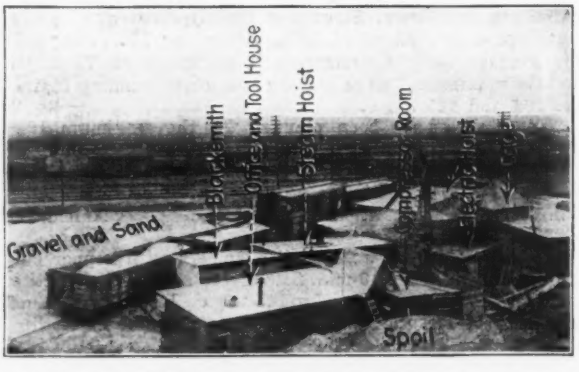


FIG. 1. COMPACT PLANT LAYOUT CONCENTRATED SURFACE OPERATIONS

ft. The three sections are constructed of reinforced concrete, the sizes being respectively 5½ ft., 7½ ft. and 9 ft., and the cross-sections, semi-elliptical. The purpose of the three-barrelled section is, first, to convey sewage from the pumping station through the 5½- ft. and 7½-ft. conduits under pressure, at a velocity sufficiently high to prevent sedimentation, to the sewage treatment plant, and, second, to convey the treated effluent back by gravity through the 9-ft. section into a large outlet conduit already constructed under the sewage pumping station. Thence the treated sewage is carried by gravity into the Sag channel, which carries it to the main drainage channel and the Illinois River.

Between the pumping station and the westerly main track of the Illinois Central R.R., a distance of 500 ft. there were a number of obstacles, such as a 5-ft. brick sewer, switch tracks, building material and the footings of the new power plant building, all of which had to be taken into account before the work started. From the west line of the Illinois Central right of way to the east line of the Western Indiana R.R. right of way, a distance of approximately 1,150 ft., the Illinois Central has more than 50 tracks, and the Western Indiana, 3 tracks. In accordance with the terms of the easements granted by the railroad companies, all work on their respective properties had to be carried on in tunnel. The contractor for the work located the shaft about 100 ft. west of the Illinois Central R.R., Fig. 1, and sunk a 30-ft. square shaft 29 ft. deep, installing a hoist, a concrete mixing plant, an air compressor plant, material track, cement shed, storehouse, blacksmith shop and office. Over the concrete mixing plant is a large heated

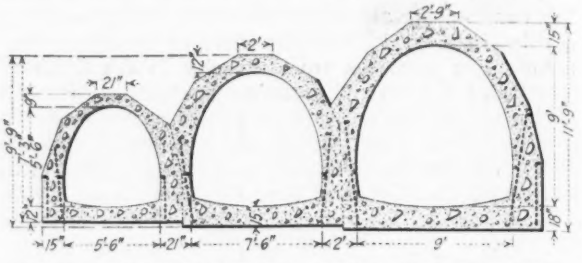


FIG. 2. THREE-BARRELED SEWER TUNNEL LINING

locker room for the use of the men, thus giving them a safe place for their clothes and a warm place for dressing.

The peculiar shape of the tunnel, as shown in Fig. 2, and the closeness of the railroad tracks to the roof (the distance from the top of the rail to the outside of concrete being approximately 16 ft.) made it apparent that the entire section could not be economically tunnelled in one operation. The outside width of the completed conduit is approximately 30 ft., and the maximum height, 12 ft. The soil is a blue glacial clay, tenacious, dry and difficult to pick. The amount of excavation on the 7½-ft. section is 3½ cu.yd. per foot, and on the whole section is approximately 9½ cu.yd. The amount of concrete per foot for the whole section is approximately 4.2 cu.yd., with 80 lb. of reinforcing steel. Considerable discussion was had between the contractor, his superintendent, and his engineer as to the method and plan to pursue, and after analyses of the earth stresses were made, the decision was reached to excavate and concrete the central, or 7½-ft. section, first, and after the concrete had received a set of at least 48 hours to follow up with the 5½-ft. section on the north and the 9-ft. section on the south.

Work on the shaft was started early in November, 1920, and on account of the critical freight car situation, especial effort was made to store sand, gravel and cement, so that when excavating and concreting started no delay from lack of materials would be experienced. About 50 per cent of the materials for the whole job were on the site before tunneling was started on Nov. 28. The disposal of the excavated material, amounting to approximately 22,000 cu.yd., was solved by purchasing eight acres of low land south of and adjoining 125th St. Two headings were started, one to the west toward the pumping station and the other to the east, and, on account of the delay in getting air tools, tunnelling was carried on in the usual manner without the use of compressed air.

Under ordinary tunnelling methods, progress is determined by the amount of material which can be mined in each shift. A foreman, five miners, two muckers and one car pusher are considered a working unit, and in tunnel work in soil of this character and degree of hardness the rate for each miner has been 3 to 4 cu.yd. for each 8-hr. shift. The introduction of the compressed air shovel and pick has revolutionized progress. Instead of the miners setting the pace, the problem is to remove the muck so that the miners can be kept reasonably busy. A foreman, four miners, six muckers

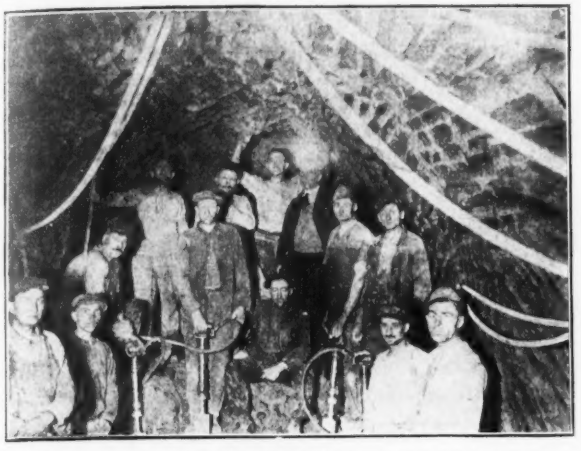


FIG. 3. TUNNEL HEADING SHOWING MATERIAL AND PNEUMATIC SHOVEL GANG

and two car pushers are the working unit in one heading, with a rate of output of from 8 to 10 cu.yd. per miner per 8-hr. shift. In two 8-hr. shifts 18 miners excavated as high as 196 cu.yd. The muck is removed in standard half-yard tunnel cars. The view, Fig. 3, shows the crew and the air tools in the heading for the 7½-ft. section, the outside dimensions of which are approximately 10 x 10 ft.

From the start, the progress of the work has been phenomenal. Two 8-hr. shifts mining and one 8-hr. shift concreting, have completed between 20 and 25 lin.ft. of tunnel. This exceeds by far any of the records heretofore made on work of this character in this locality. The progress in excavation during the first 58 days of tunnelling was: 764 ft. of 9-ft. section, 883 ft. of 7½-ft. section and 864 ft. of 5½-ft. section, which is equivalent to 822 ft. of the entire section, or a rate of 14.2 ft. per day. The progress during the two weeks prior to Feb. 1 has greatly exceeded the average, so that the slogan on the job is now "Get at least one foot of completed tunnel every hour" for six working days. The recent daily reports indicate this to be the performance. This progress is due not only to the introduction of the compressed air pick and shovel, but also to the efficiency of the contractor's organization. The air picks and shovels are operated by Little David hammers made by the Ingersoll-Rand Co. The actual cost of excavation from the heading in the tunnel to its final disposal on the dump was slightly less than $5 per cubic yard. The rate of pay for miners is $1.25 per hour; muckers, $1.12½ per hour, and other labor, $1 per hour.

The digging blades were specially designed for this job, and a considerable amount of money was expended in getting the proper shape commensurate with ease of handling. The most satisfactory size is 5 x 9 in. and the best weight is 7½ lb. The character of the steel for the blades was a problem which was difficult of sclution. The repeated stress and strain within the steel due to air gun, caused the cutting tools to break at the most unexpected times, so that a large supply of these had to be kept on hand. Fig. 4 shows the details of this shovel. Considerable saving in the construction cost was possible because of the character of the ground which is such that even with the railroad traffic over the roof of the tunnel it is unnecessary to place any cants or timbers. The tunnel work is also carried on without compressed air except as it is used to operate the digging tools.

A 1:2½:4½ concrete is mixed on the surface in a 14-cu.ft. capacity batch mixer and spouted down into the tunnel into half-yard tunnel cars. Segmental steel tunnel forms of the Blaw type are used. As the concreting on the 7½-ft. section progresses, openings 5 ft. high by 7 ft. long are left in the north and south walls at frequent intervals, which are of great help in constructing the 9-ft. and 5½-ft. sections. By means of these openings the tracks of the lateral tunnels are connected to those in the 7½-ft. section.

The entire plant is operated by electricity, the hoist, the concrete mixers and the air compressors. Coal is used for heating aggregate and water in severe weather. The air compressor is of the two-stage belt-driven Ingersoll-Rand type XB having a capacity of 600 cu.ft. per minute and giving an air pressure of 100 lb. which is capable of handling 15 to 18 air picks. The installation of the compressed air plant for the

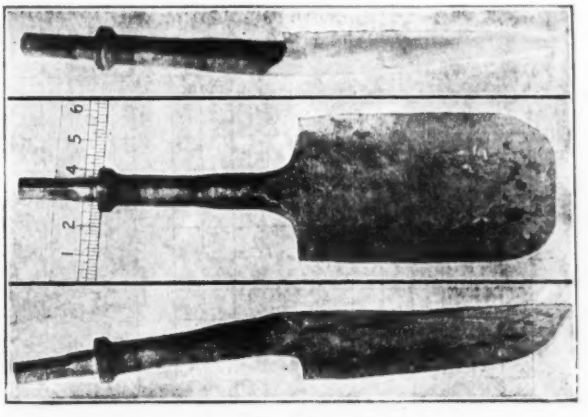


FIG. 4. PNEUMATIC SHOVEL BLADE

operation of the picks and shovels made unnecessary the installation of fans and blowers for ventilation purposes. While excavation is in progress, there is an abundance of air from the hammer exhausts. During the concreting shift, the air valves are opened into the tunnel and the compressor operated at a pressure of 30 lb. Excellent ventilation is obtained in this way.

The contract requires the completion of all of the work before May 1, 1922. On Feb. 1, 1921, 40 per cent had been completed, and unless unforeseen conditions arise, the entire contract will be completed before June 1, 1921. The contractor is the American Sewer & Drain Construction Co., Chicago, with Dan O'Conner as superintendent. The work is being paid for by the Sanitary District of Chicago on the basis of lineal feet of completed tunnel, with the usual clauses regarding additional payment for excavation, concrete, etc., outside of the specified dimensions or quantities. A. W. Dilling is chief engineer and Langdon Pearse is sanitary engineer, of the District, and L. D. Barker is resident engineer in charge of construction.

Road-Making Machinery Exports

Exports of road-making machinery during January, 1921, were valued at $77,875. This compares with $51,411, the value of the exports during January, 1920. The figures are those of the Bureau of Foreign and Domestic Commerce.

Higher Stresses for Bridge Pins

Tests of Iron and Steel Pins Show Usual Flexure Theory Inapplicable—Formulas for Practical Use

By D. B. Steinman
Robinson & Steinman, Consulting Engineers, New York

STRESS conditions in bridge pins have received scant attention in the past. From a study of available data the writer is led to propose a material increase in allowable bending stress over values permitted in present specifications, and to suggest the use of a straight-line formula for that stress so as to take into account the span ratio l/d.

Although of minor importance in new designs, the question of proper working stress for pins assumes economic importance in the rating of existing bridges. In consequence of initial unscientific packing or of subsequent increase in bridge loading pins are often found to have critical bending stresses; and a knowledge that these stresses are safe would relieve the engineer of the alternative of restricting traffic or of ordering expensive and difficult repairs.

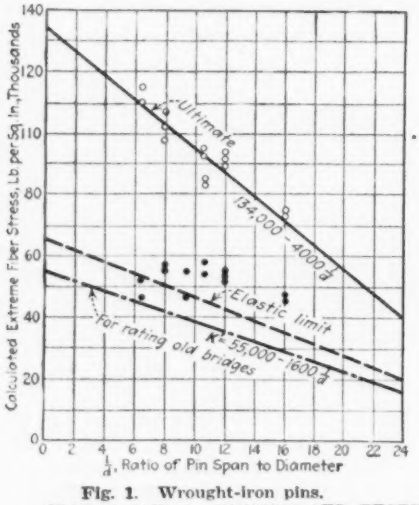

Calculated Extreme Fiber Stress, Lb. per Sq. In., Thousands
Ultimate
134,000 - 4000 l/d
Elastic limit
For rating old bridges
K = 55,000 - 1600 l/d
l/d, Ratio of Pin Span to Diameter

Fig. 1. Wrought-iron pins.

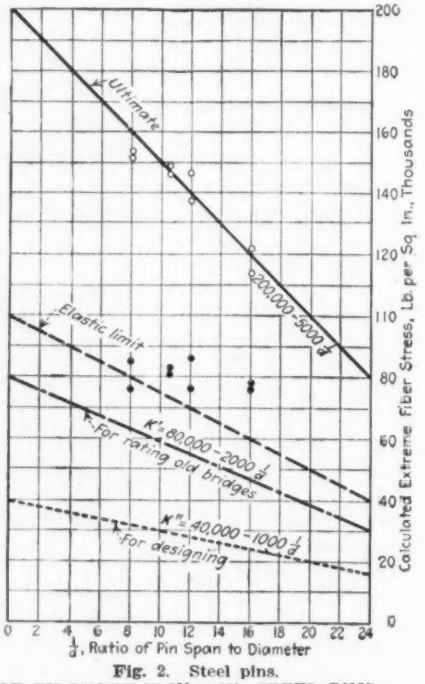

Ultimate
K = 200000 - 5000 l/d
Elastic limit
K' = 80,000 - 2000 l/d
For rating old bridges
K'' = 40,000 - 1000 l/d
For designing
Calculated Extreme Fiber Stress, Lb. per Sq. In., Thousands
l/d, Ratio of Pin Span to Diameter

Fig. 2. Steel pins.

FIGS. 1 AND 2. RENSSELAER TESTS OF WROUGHT-IRON AND STEEL PINS

The writer has found, in old railway and highway bridges, calculated pin stresses far in excess of those usually regarded as safe, without any visible signs of overstress. A reassuring interpretation of such conditions is disclosed in the results of experiment.

The only pin tests of which any record could be found by the writer were made nearly forty years ago. Burr, in his "Elasticity and Resistance of the Materials of Engineering," 1915 e.c.d., pp. 557, 559, reports a series of tests made in 1882 at Rensselaer Polytechnic Institute on comparatively short cylindrical beams of wrought iron and steel. Tests on wrought-iron bridge pins made at the Watertown Arsenal in 1881 are reported in Executive Document 12, 47th Congress, 1st Session, pp. 171 to 195 (see Lanza's "Applied Mechanics," 1897 ed., p. 525). The fiber stresses and span ratios calculated from those records are plotted in Figs. 1, 2 and 3, respectively.

The wrought iron pins tested by Burr were ¾ in., 1 in. and 1¼ in. in diameter and were tested with spans of 8 and 12 in. The calculated fiber stress (K) at the ultimate load ranged from 74,000 lb. per sq.in. for a span-length of 16 diameters to 115,000 for a span length of 6 diameters, or from 1.3 to 2.1 times the direct tensile strength of the material, which was 55,000. The inverse variation of ultimate fiber stress with slenderness ratio was consistent throughout, as shown by the plotted values. The points lie very close to a straight line yielding the formula,

$$\left.\begin{matrix}\text{Ultimate } K \\ \text{for wrought-iron pins}\end{matrix}\right\} = 134{,}000 - 4{,}000\, l/d \qquad (1)$$

In the same experiments, the calculated fiber stress at the elastic limit of the beams under test ranged from 46,000 to 58,000, or about twice the value in direct tension, which was about 28,000 lb. per sq.in. The elastic-limit stresses are also plotted in the diagram, and are seen to be more than one-half of the ultimate.

The steel pins tested by Burr were ¾ in. and 1 in. in diameter and were tested with spans of 8 and 12 in. The calculated fiber stress K at the ultimate loads ranged from 114,000 for a span of 16 diameters to 153,000 for a span of 8 diameters, or from 1.7 to 2.3 times the direct tensile strength of the material which was about 67,000 pounds per square inch. Plotting the individual tests, Fig. 2, the points are found to lie approximately along a straight line yielding the formula,

$$\left.\begin{matrix}\text{Ultimate } K \\ \text{for steel pins}\end{matrix}\right\} = 200{,}000 - 5{,}000\, l/d \qquad (2)$$

In the same experiments, the calculated fiber stress at the elastic limit (also plotted) ranged from 76,000 to 86,000, or over twice the value in direct tension (37,000 lb. per sq.in. and higher than one-half of the ultimate.

The Watertown Arsenal tests were made on wrought-iron pins 2½, 3, 3½, 4 and 4.88 in. in diameter, with spans of 6, 12, 18 and 24 in. The maximum loads applied (*without producing failure*) corresponded to calculated fiber stresses of 92,000 for a span of 6 diameters to 141,000 for a span of 2 diameters, or from 1.8 to 2.8 times the direct tensile strength (50,000 lb. per sq.in.). These values are plotted in Fig. 3, together with the straight line representing formula (1), deduced from the Rensselaer tests, in order to show that the straight-line formula may safely be extended to slenderness ratios as low as 2 diameters.

The foregoing analysis of tests serves to emphasize two conclusions:

1. The modulus of rupture (K) for pins is far beyond the ultimate resistance to tension, even two or three times as great.

2. The modulus of rupture of pins increases in a marked degree with diminishing ratio of pin-span to diameter (l/d).

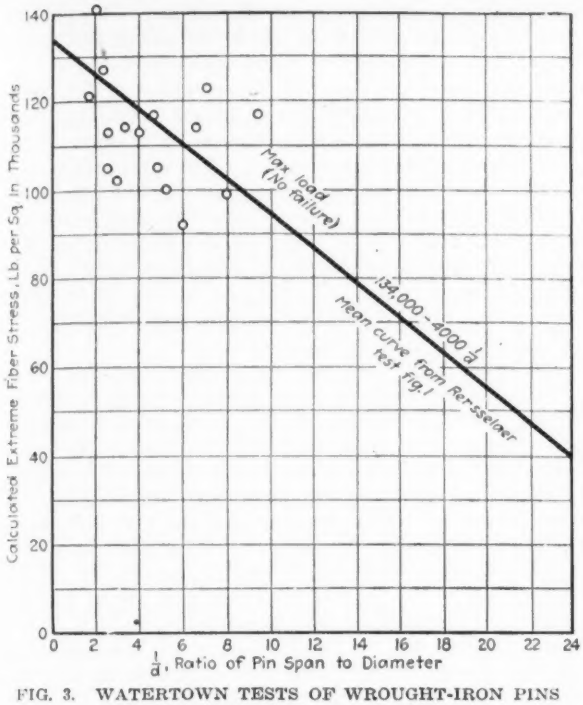


FIG. 3. WATERTOWN TESTS OF WROUGHT-IRON PINS
These tests were not carried to failure.

To account for these observed effects, different explanations may be advanced:

(a) In pins, more than in other beams (on account of the circular section), the extreme fibers are supported or assisted in sustaining their maximum stress by a large mass of adjoining fibers having a lower stress.

(b) In all beams, because of the disproportionate increase of stress with strain after the elastic limit is passed, the modulus of rupture calculated by the common theory of flexure is greater than the actual extreme-fiber stress at failure.

(c) The assumption that the loads and reactions are concentrated at their centers instead of distributed over the widths of bearings gives higher values than the true moments.

(d) Any slight bending of the pin results in some readjustment of the applied forces which tends to reduce the moments below the values calculated.

(e) A pin is a *short beam* in which the loads are carried across largely by transverse shear and compression, to the relief of ordinary flexure. Stresses calculated by the common theory will be correspondingly higher than the actual stresses. (This is essentially the explanation suggested by Burr).

(f) The loads applied on the outer fibers are distributed approximately along 45 deg. lines before reaching the neutral axis. This effect alone would explain an excess of calculated over actual stress amounting to 11 per cent for $l/d = 10$, 25 per cent for $l/d = 5$, and 100 per cent for $l/d = 2$.

A combination of some or all of the hypotheses just enumerated ought to account for the phenomenally high stresses observed in the pins, and for the variation of ultimate strength with slenderness ratio.

In applying the formulas above derived from the tests cited, a low factor of safety is justified, as there is no danger of the bending moments being greater than calculated and there is a practical certainty that they are somewhat less.

For rating old bridges, with the moments calculated as usual by assuming the loads applied at the centers of their bearings on the pins, a factor of safety of 2½ should be ample. This will give

$$\left.\begin{matrix}\text{Allowable } K' \\ \text{for steel pins}\end{matrix}\right\} = 80{,}000 - 2{,}000\ l/d \quad (3)$$

$$\left.\begin{matrix}\text{Allowable } K' \\ \text{for wrought-iron pins}\end{matrix}\right\} = 55{,}000 - 1{,}600\ l/d \quad (4)$$

According to the values plotted in Figs. 1 and 2, pins figured for these stresses (K') will be stressed about 20 per cent below the elastic limit.

For *designing,* a factor of safety of 5 is certainly generous. This will give a working stress

$$\left.\begin{matrix}\text{Allowable } K'' \\ \text{for steel pins}\end{matrix}\right\} = 40{,}000 - 1{,}000\ l/d \quad (5)$$

instead of 24,000 as at present specified. Eq. 5 is also plotted in Fig. 2, in order to exhibit its safety in comparison with the ultimate fiber stresses.

A confirmation of the safety of the above formulas for figuring pins is found in the Watertown Arsenal reports, in the record of a wrought-iron pin stressed in the testing of a latticed channel column (previous reference, pp. 161, 171). The pin, 14 in. long and 3 in. in diameter, loaded at two points and supported at three, safely withstood a load of 388,500 lb., at which the column failed. The extreme-fiber stress in the pin calculated for this loading was 102,000 lb. per sq.in., or more than double the maximum permissible stress proposed in eq. (4), above.

Further Tests Desirable

The tests plotted in Figs. 1, 2 and 3 seem to afford convincing proof that very high bending stresses may safely be permitted in bridge pins. Additional experiments, however, are highly desirable, in order to confirm the conclusions and to make the information on the subject more complete. In the light of present knowledge, the tests can be more comprehensively planned; and the strain-gage can be applied to ascertain the actual fiber stresses in the pins. The data thus secured will not only be a contribution to the science of stresses, but will also be of economic significance in questions concerning the rating or reinforcement of existing bridges.

Railway Mileage in 1920

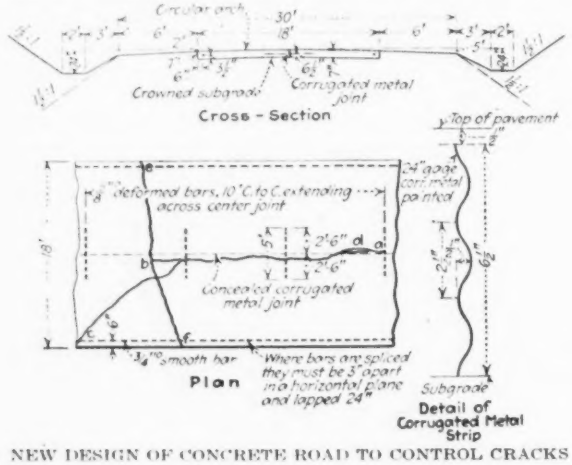
Railway construction reduced nearly to the zero point and more than balanced by mileage of line abandoned, resulting in a net decrease in the total railway mileage of the United States for the year 1920, is shown in statistics compiled by the *Railway Age.* Only 314 miles of new line were built, the longest stretch being 37 miles on the Alaska Government Railway. This is the lowest record for many years and it is only in the past few years that the record has been below 1,000 miles: 979 miles in 1917, 721 in 1918 and 686 in 1919. On the other hand, there were 713 miles of line abandoned in 1920 (on which 240 miles of track were taken up), giving a net loss of nearly 400 miles in the total railway system. From 1,420 miles of line built in 1895 the record rose to 6,026 miles in 1902 and then declined to about 3,000 miles for each of the years 1911, 1912 and 1913, followed by a sudden drop to 1,532 miles in 1914 and 933 in 1915, with a slight rise to 1,098 miles in 1916.

Illinois Has New Concrete Road Slab Design

Corrugated Iron Strip Down Center of Slab and Smooth Rod Reinforcement at Sides To Localize Cracking

CONTROL of longitudinal cracks and reduction of corner-crushing at transverse cracks, are sought in the new slab design for concrete roads in Illinois. Details of the new design are given by the accompanying drawing. All concrete roads on which bids are asked this year are of the design shown. This is the only change in the specifications except that stockpiling of aggregates on the subgrade is prohibited.

It is not practicable completely to prevent longitudinal cracks. In general they will occur on a very



NEW DESIGN OF CONCRETE ROAD TO CONTROL CRACKS

considerable portion of the mileage of any long-completed concrete road. With a monolithic slab they will be irregular as at *ab;* sometimes they will run off the slab as at *c*, and sometimes they will bifurcate, forming a weak spot, as at *d*. By providing the concealed corrugated metal joint, the theory is that the forces which form longitudinal cracks of irregular alignment will find relief in opening up the concealed joint. There will be a longitudinal crack, but it will be controlled in alignment. In this manner the appearance of the road will be improved and longitudinal cracks will be prevented from running to the edge of the pavement, thereby creating weak corners which tend to break down under traffic as described in *Engineering News-Record*, Feb. 3, 1921, p. 210.

The corrugated metal strip used to form this longitudinal joint is ½ in. less in width than the depth of the slab, and therefore does not interfere with tamping and finishing operations. The corrugations form an interlocking joint which prevents separate movement of the adjacent edges. These corrugations are held in mesh, and the joint prevented from opening, by the deformed bar dowels or ties extending across the joint as illustrated.

In specifying the construction of the joint, the corrugated metal is No. 24 gage painted metal, having a width of corrugation of 2½ in. and a depth of corrugation of ½ in. This is the standard commercial article which is obtainable universally from mills and warehouses. The painted metal is specified since it is the standard commercial article and to emphasize the fact that galvanized metal is not required. In case contractors desire to use old stock, or corrugated metal which is not painted, or metal which is heavier than 24 gage, such practice will be permitted. The metal may be used in strips of any length which the contractor desires. The joints may be butt joints or lap joints, at the contractor's option. The corrugated metal shall be held in place prior to and during the depositing and finishing of the concrete, by any method which the contractor may choose, provided the metal is not displaced during these operations. Small iron stakes, which may be removed or left in place at the contractor's option, will probably afford the most economical method of supporting this joint.

In order that the ¾-in. round bars, which extend across the longitudinal joint at 10 ft. centers, may be easily placed, it will be acceptable either to punch the corrugated strips or to make vertical open slots to receive the bars. These bars must be deformed or rough-surfaced bars, which will bond with the concrete, as they are used for tie bars to hold the two 9-ft. slabs in place. No paint, grease, nor asphalt shall be placed on these bars. The use of any deformed or rough-surfaced bar, the area of which is equal to or greater than a ¾-in. round bar, will be permitted.

In addition to the longitudinal joint, the new slab design, as illustrated, calls for ¾-in. round, smooth, painted longitudinal bars located 6 in. inside the edge of the slab and on the neutral axis. These are not, properly, reinforcing bars; they are designed to bridge across a transverse crack as *ef*, so that the adjacent corner slabs will act together under load and thus tend to reduce the corner breakage described in *Engineering News-Record*, Feb. 3, 1921, p. 210. It is intended that these bars shall not bond with the concrete. To this end they are smooth, round bars painted with one coat of red lead and then coated with hot asphalt. The paint coat is also designed to resist rusting action.

Incidentally, in specifying the construction of this improved slab, corrugated transverse construction joints are required. At all such points corrugated metal strips similar to those specified for the longitudinal joint are to be placed against the header board before concrete is deposited. The ¾-in. round smooth bars at the edges of the pavement are required to project at least 24 in. beyond the construction joint. In order to facilitate the removal of the wood header and the placing of the bars, it will be permissible to place a vertical open slot in both the corrugated metal strips and the wood header.

The revised concrete slab design has been worked out under the direction of Clifford Older, chief highway engineer of Illinois.

Repeated Reversal Stress Tests in Concrete Beams

In a recently issued Technologic Paper (No. 182) of the Bureau of Standards W. A. Slater, G. A. Smith and H. B. Mueller report on the tests made for the Concrete Ship Section of the United States Emergency Fleet Corporation during the war on the effect of repeated reversals of stress on doubly reinforced concrete beams. The intended scope of the test program was cut down by the end of the war so that the information available is nowhere near as complete as was originally expected. The record of tests is given very completely in the bulletin and serves as a reference for future investigations of this sort.

Plant Layout Studied by Concrete Institute Committee

Report Submitted at Annual Convention Embodies Description of, and Comparative Costs Upon Seven Fundamental Types

IN ORDER to guide the contractor in his choice of equipment for average concrete building construction, the special committee on contractors' plant of the American Concrete Institute reported at its annual convention in Chicago, Feb. 14-16, upon fundamental types of equipment for receiving materials, and mixing, hoisting and placing concrete, and accompanied the report with certain data concerning the cost, per cubic yard, of concrete, including the cost of plant installation and operation. After studying numerous concrete plants in successful operation, the committee came to the conclusion that no recommendations could be made for a standard plant layout to meet all conditions. However, it did report that under ordinary circumstances there was no justification for the installation of an elaborate plant, unless an analysis showed the saving in labor cost to operate to be greater than the cost of the plant required to save that labor.

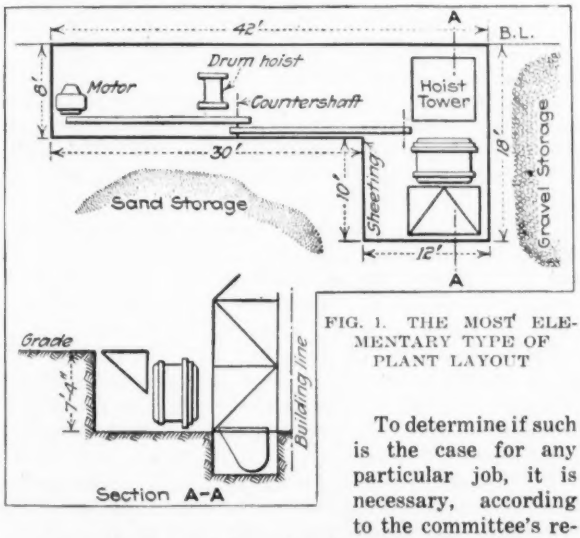


FIG. 1. THE MOST ELEMENTARY TYPE OF PLANT LAYOUT

To determine if such is the case for any particular job, it is necessary, according to the committee's report, to make for each layout under consideration a careful estimate of the cost of plant installation and operation, per yard of concrete. This process of estimating could be simplified by the use of charts to be drawn up by the contractor, based on the contractor's own records of cost for installation and operation, and his depreciation or rental charges. With these analyses in hand, the committee considered it possible to make a comparison that would weigh the merits of each scheme from an operating standpoint and at the same time tell whether the proposed outlay for plant required under it would be justified by the saving it offered.

So the committee found that, owing to local conditions or peculiar requirements as to speed, labor saving, winter weather, etc., anything approaching a single standard arrangement of plant was out of the question. Most of the layouts visited, however, were found capable of being grouped into seven fundamental arrangements, developing from a very elementary form by the addition of equipment intended to conserve labor, thus making

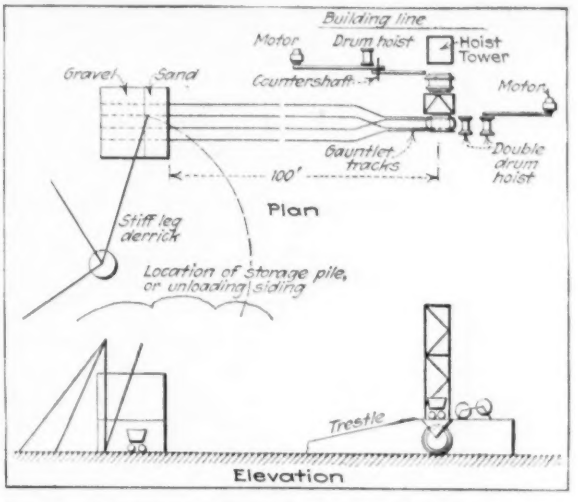


FIG. 2. THE TYPE OF PLANT LAYOUT WHICH EMBODIES THE GREATEST EQUIPMENT EXPENSE

possible a comparison between the additional money expended for plants and the saving in labor costs as a result of its use. The most elementary form of plant layout is indicated in Fig. 1 and the most pretentious layout, which corresponds to No. 7 in the committee's report, is indicated in Fig. 2.

A survey of the individual operations of unloading, transporting and receiving, as well as the combination function of mixing, hoisting and placing concrete, showed the advisability to the committee of separating from the others the unloading and transporting operations. As these two operations were considered in themselves subject to such a large number of possible combinations of methods, they were omitted entirely by the committee, plant layout as affecting the receiving of materials and the mixing, hoisting and placing of concrete being alone considered. These seven plant layouts, described as to the fundamental methods of operation, are as follows:

1—(Shown in Fig. 1) Mixer in a pit. Sand and gravel is dumped on the ground on each side of the mixer pit. The mixer is charged by hand, using 6-cu.ft. carryalls.

2—Sand and gravel are unloaded from back-dump motor trucks against a bulkhead at the charging hopper. Laborers are required to trim material in the bulk head, but wheeling is not required.

3—Sand and gravel are delivered to a storage pile, and rehandled from the storage pile to the mixer bulkhead by a stiff-leg derrick with a clam-shell bucket. The derrick may also be used for unloading cars or scows and handling to storage.

4—The mixer is above ground. Sand and gravel are delivered to the storage piles and rehandled to a 100-cu.yd. bin over the mixer by a stiff-leg derrick. The derrick may also be used for unloading cars or scows and handling to storage.

5—The mixer is on the ground. A material bin is above the mixer. Sand and gravel are delivered in back-dump trucks and unloaded into a conveyor boot built into the ground. A chain-belt-bucket elevator conveys the sand and gravel from the hopper to the bin.

6—The mixer is in a 3-ft. pit to avoid sheeting. There is a bulkhead against the charging hopper. Sand and gravel are piled against this bulkhead by a 24-in. belt conveyor from a conveyor boot in the street.

7—(As shown in Fig. 2). The mixer is above the ground. Sand and gravel are received by car or scow and unloaded

into a 100-cu.yd. bin by a stiff-leg derrick. The material is handled from the bin to the mixer in 1-yd. side-tip cars drawn by an endless cable from a double-drum hoist.

In determining the cost, per cubic yard of concrete, of plant installation and operation of the seven fundamental types of layout, several assumptions were made. It was taken for granted that on jobs of less than 3,000 yd., a ¾-yd. plant would be used, a 50-ft. wooden tower, eight carryalls for placing concrete, and 300 ft. of run panels. Jobs over 3,000 yd. would have a 1-yd. plant, a wooden tower averaging 125 ft., twelve carryalls for placing concrete, and 400 ft. of run panels. These factors were assumed as average equipment, went on

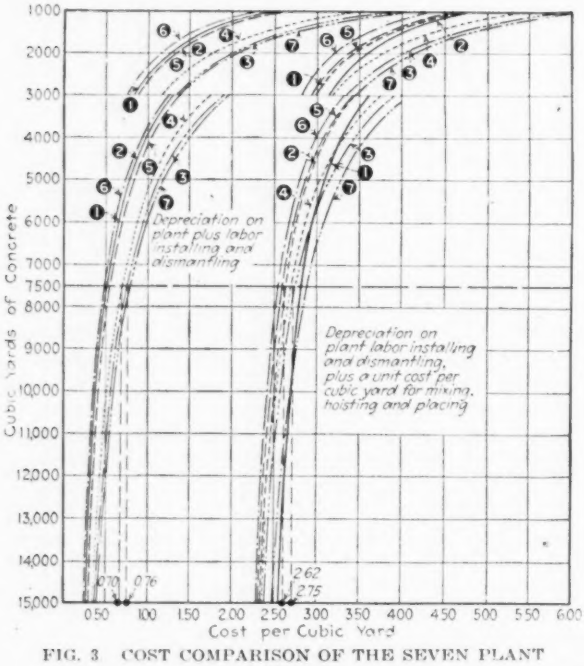

Cubic Yards of Concrete
Depreciation on plant plus labor installing and dismantling
Depreciation on plant labor installing and dismantling, plus a unit cost per cubic yard for mixing, hoisting and placing
.070
.076
.262
.275
Cost per Cubic Yard

FIG. 3 COST COMPARISON OF THE SEVEN PLANT LAYOUTS

the committee's report, and as many contractors standardize on 1-yd. chuting equipment, this was used for both ¾ and 1-yd. mixer plants, but with a 100-ft. steel tower for the ¾-yd., and a 180-ft. steel tower for the 1-yd. plant. Variations from this average, in a case of any job of medium size, would involve only a slight difference in cost per yard when pro-rated over the entire yardage. On extensive operations a slight difference in cost per yard between several plants would naturally warrant a careful individual estimate of each.

The committee pointed out that any contractor might plot for himself a set of curves as are indicated on accompanying charts, based upon his own layout, by keeping a record of the cost of installing and dismantling each arrangement and adding thereto his allowance for plant depreciation. As plant obtained by a contractor on a rental basis costs more than the depreciation allowances made by the committee, such conditions should be taken into consideration in plotting similar curves and in estimating for jobs where it will be necessary to rent part of the equipment.

In plotting the curves shown in Fig. 3, which is a comparison of costs of the various plants, depreciation was figured on jobs running from nine months to a year. For jobs of shorter duration, the depreciation allowances herein stated would be slightly high. For the

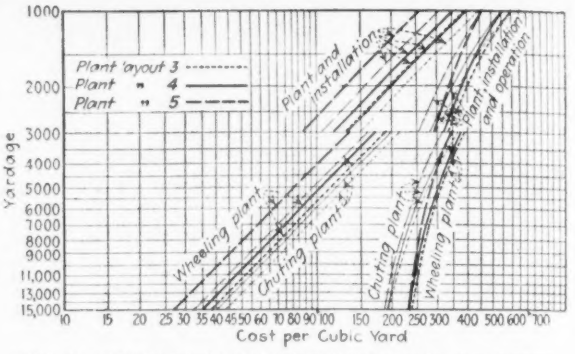


FIG. 4. COMPARISON OF WHEELING CHUTING COSTS ON PLANT LAYOUTS 3, 4 AND 5

¾-yd. plant the depreciation has been taken at 60 per cent of that for the larger plant. This yearly depreciation was figured as 40 per cent in the case of a bucket elevator; 33 per cent for carryalls; and 20 per cent for concrete buckets, hoists, mixers, motors, side-tip cars, steel-hoist towers, and stiff-leg derricks. Frame structures, such as bins, bulkheads, wooden towers, etc., were considered a complete loss, owing to the uncertain salvage value of such material and the widely varying practices in regard to selling, storing, etc. The committee found that labor to dismantle would, in general, be found to offset any salvage.

An estimate of the labor required for the operation of each plant, that is, mixing, hoisting and placing, has as a basis a labor rate of $6.50 per 8-hr. day. This unit cost per cubic yard for mixing, hoisting and placing was estimated for the seven fundamental types of layout as follows: Plant No. 1, $2.30 per cubic yard; No. 2, $2.10; No. 3, $2; No. 4, $2; No. 5, $2.05; No. 6, $2.05, and No. 7, $2.10. These figures assume the placing of concrete by wheeling. The right-hand curves in Fig. 3 show the depreciation on a plant of the seven types, including the labor of installing and dismantling the plant, plus this unit cost per cubic yard for mixing, hoisting and placing, whereas the left-hand curves show the depreciation on the plant, plus the labor of installing and dismantling the plant.

To analyze further each arrangement, seven additional charts were prepared by the committee on which comparison was made between wheeling as a means of placing and chuting, using steel-hoist tower, 50-ft. boom and counter weight truss, to eliminate wheeling on the floor. The charts were drawn indicating yardages per mixer.

In Fig. 4 are shown these differences in cost of plant installation and operation between the chuting and wheeling methods. The curves in Fig. 4 are based upon plant Nos. 3, 4 and 5. In explanation of the use to which the curves in Fig. 4 may be placed, the following illustration is taken from the report of the special committee:

A building containing 15,000 yd. of concrete, for which it is desirable to use two mixing plants, is taken as an example. Choice lies between plants of the type of No. 3 and No. 4 where the contractor unloads the material, and a plant similar to No. 5, for which the material is delivered by a dealer. It will be assumed that yardages handled by the two plants are approximately equal. Comparison will then be made on the basis of 7,500 yd. per mixer. Comparing first plant Nos. 3 and 4, it is found that the cost per yard for plant and installation are respectively 76 cents and 70 cents. The combined cost for plant installation and opera-

tion is $2.81 and $2.75 respectively. Choice is therefore between No. 4 and No. 5, which shows a total of $2.62, 13 cents per yard less than No. 4.

To these figures, however, must be added unloading for No. 4, and unloading and trucking for No. 5. These figures will ordinarily run about 20 cents for No. 4 and 50 cents for No. 5, assuming a mile haul and disregarding the dealer's profit on the transaction. The revised figures now stand:

No. 4—Plant installation and operation, $2.75 + $0.20 = $2.95.

No. 5—Plant installation and operation, $2.63 + $0.50 = $3.12,

If the contractor has chuting equipment he will refer to chart marked plant No. 4, which is a comparison between placing by wheeling and chuting. At 7,500 yd. he will find the chuting equipment will cost him 11 cents more per yard in plant charges, it will save him 40 cents net on the combined total of plant installation and operation. The additional plant charge for chuting equipment is therefore justified by the saving in labor charges.

Effect of Train Speeds on Increasing Track Maintenance Costs

Abstract of subcommittee report, Committee on Economics of Railway Operation, American Railway Engineering Association. Prepared by C. C. Williams and J. M. Burt.

DISCUSSION of the effect of increased speed on the cost of track maintenance requires recognition of two distinct points: (1) Necessarily higher maintenance standards under higher speeds, and (2) increased costs from actual damage by trains due to increased speed. Confining the study to the second point, experience has shown that greater increases in maintenance costs arise from increasing freight train speeds than from increasing passenger train speeds. Observations also indicate that such increases in maintenance costs are not as pronounced on tangent track as on curves.

Force exerted by track in deflecting the mass of locomotive or car, in interference with the natural period of oscillation due to high speeds, will vary as the first power of the velocity of the train. As indicated by tests of behavior of track under traffic the variation is a direct one. The equations for the maintenance of way and structure expenses may therefore be written in the following form:

Ties	Cost = $A(1 + K_tV)$
Rails	Cost = $B(1 + K_rV)$
Ordinary track maintenance	Cost = $C(1 + K_mV)$
Ballast	Cost = $D(1 + K_oV)$
Track laying and surfacing	Cost = $E(1 + K_lV)$
Superintendence	Cost = $F(1 + K_sV)$
Bridges, trestles and culverts	Cost = $G(1 + K_gV)$

The factors A, B, C, etc., are the costs of various tiems at any given speed of operation and the co-efficients K_t, K_r, etc., are the factors indicating the increase per mile per hour increase in speed. From calculations based on previous investigations the value of K_t, K_r, etc., are as follows:

Co-efficient	For Passenger Trains — Tangent Track	For Passenger Trains — Curved Track	For Freight Trains — Tangent Track	For Freight Trains — Curved Track
K_t	0.0011	0.0150	0.0014	0.0180
K_r	0.0010	0.0082	0.0031	0.0082
K_m	0.0008	0.0038	0.0008	0.0040
K_o	0.0010	0.0038	0.0012	0.0045
K_l	0.0022	0.0190	0.0027	0.0210
K_s	0.0022	0.0190	0.0029	0.0210
K_g	0.00067	0.00067	0.0009	0.0009

In illustration of application of the above analysis: It is proposed to increase average speed of freight trains from 20 to 25 m.p.h. over a road of 75 per cent tangent, 25 per cent curves. If the road is one carrying both passenger and freight traffic, the passenger traffic will establish the standard of maintenance necessary. Therefore, the question of a higher standard of maintenance will not be involved and the increase in maintenance expense will be attributable only to increased speed of freight operation as follows:

Tie expense	$100(0.0014 \times 0.75 + 0.018 \times 0.25) \times 5 = 2.8$ per cent
Rail	$100(0.0031 \times 0.75 + 0.0082 \times 0.25) \times 5 = 2.2$ per cent
O. T. M	$100(0.00080 \times 0.75 + 0.0040 \times 0.25) \times 5 = 0.8$ per cent
Ballast	$100(0.0012 \times 0.75 + 0.0045 \times 0.25) \times 5 = 1.0$ per cent
Track laying and surfacing	$100(0.0029 \times 0.75 + 0.021 \times 0.25) \times 5 = 3.7$ per cent
Superintendence	$100(0.0029 \times 0.75 + 0.021 \times 0.25) \times 5 = 3.7$ per cent
Bridges, trestles and culverts	$100 \times 0.0009 = 0.5$ per cent

Thus the increase in maintenance expenses, in this case, would be about 2.4 per cent, or approximately 0.5 per cent increase per mile-per-hour increase in speed of freight trains.

Manifestly, the effect of speed in increasing the damage done to track will be dependent upon the character of equipment and rolling stock and it is, therefore, necessary to consider the effect of increased speed of freight trains and the passenger trains separately due to different standards of maintenance in the two classes of equipment.

New Emergency Contract Devised

PAYMENT to the contractor of a designated fee, the furnishing by the contractor of all equipment and tools, the furnishing by the city of all materials, and the payment by the city of all labor costs exclusive of the wages paid a general superintendent, are the features of a new emergency contract devised by the City of Cleveland and applied in the construction of new units to the city hospital. By the terms of the contract the city becomes virtually the employer, doing the work by day labor and hiring a supervisor of labor and materials. The contract is being executed by the Central States Engineering & Construction Co.

The contractor is to furnish and deliver on the site at his sole expense, all the necessary power equipment, such as steam shovels, locomotives, dump cars, hoisting engines, motor trucks, concrete mixers and like equipment; and all necessary small tools, such as picks, shovels, crowbars, wheelbarrows, concrete buggies, etc. The contractor is also to furnish such parts as are necessary to keep the equipment in good repair.

The power equipment estimated as necessary for the construction of the buildings contemplated, and the time required for each item of equipment, is tabulated in the contract. In the event this equipment is not used for the entire length of time estimated, allowances for the release of any of it from the work are to be deducted by the city from the sum stipulated to be paid the contractor—$109,000. The monthly rate which is to be conducted in case certain items of equipment are released is as follows:

Steam shovels	$600	Power saws	50
Locomotives	300	Stiff-leg derricks	55
Dump cars	30	Guy derricks	250
concrete mixers	100	Pumps	50
Hoisting engines	100	Boilers	25
Mortar mixers	50		

The $109,000 is to be paid the contractor in installments as the work progresses, 10 per cent of the installments to be deducted and retained by the city until sixty days after the completion of the contract.

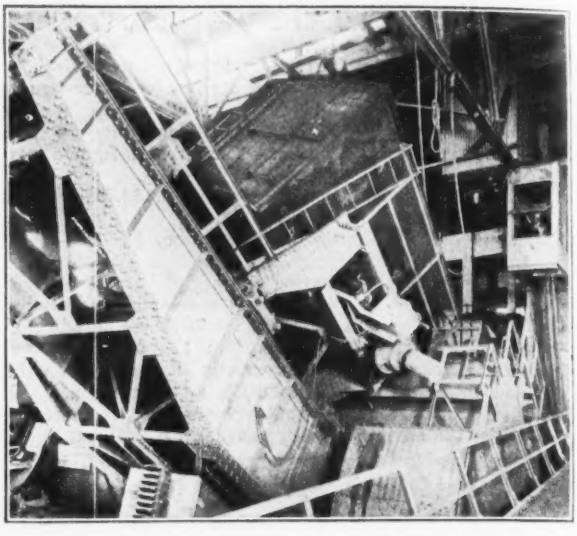
The city is to purchase all materials necessary for the construction through its purchasing department, upon estimates furnished by the company and approved by the city architect. Material deliveries are to be made by the city. Necessary supplies, such as fuel, light, oils, and water are also to be furnished by the city. Payment for labor is to be assumed by the city, the payroll for each week to be prepared by the company and approved by the city architect and director of parks and public property, the company, or contractor, being only designated as a deputy of the city in distributing to the employees the wages earned. Inasmuch as payment of labor is undertaken by the city, the contractor is held free from liability of the payment of compensation insurance, except in those cases where the contractor contributes the negligence causing accidents.

Car Dumpers for Quick Unloading at Grain Elevator

Speed Up Operation of Entire Plant and Cut Labor Force Required—Automatic Equipment Opens Grain Doors

SPECIALLY DESIGNED car-dumper units, combining an automatic device for opening grain doors, have led to increased speed of operation of the entire plant and materially reduced the labor force required at the Northern Central grain elevator of the Pennsylvania R.R. recently completed and put in operation at Baltimore. This is the first time that the car-dumper principle has been applied for the unloading of grain at elevators and heretofore it has been at this point that speed of operation has been impeded through the necessity of employing manually and mechanically operated shovel boards and hand shoveling for unloading into the sink.

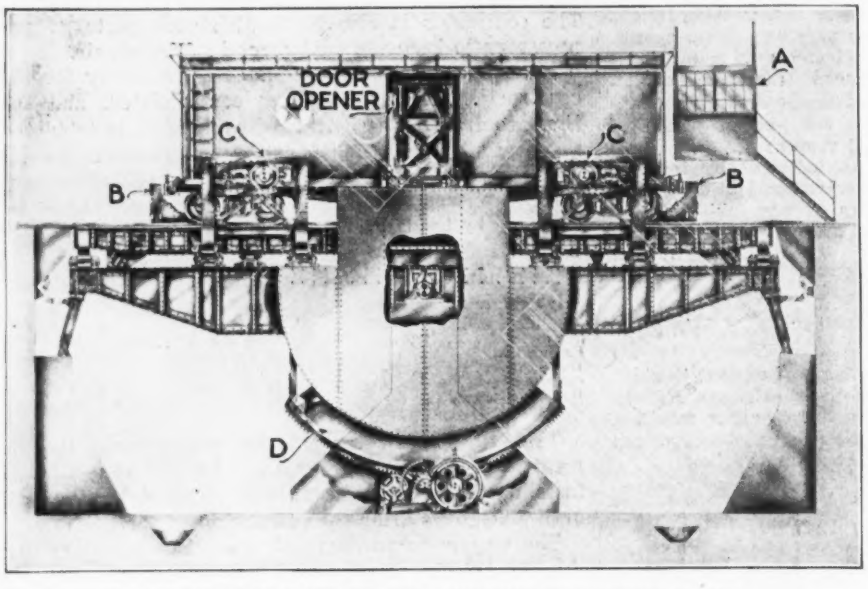
A dumper serves each of the four unloading tracks and the total time required for emptying a car, including spotting and removing, is about 7 min. At the same time it is estimated that the four unloaders replace the labor of about sixty-eight men that would otherwise have been required.



EXTREME POSITION OF BOX CAR DURING UNLOADING

Tipped lengthwise through 45 deg. and sidewise, 30 deg. Top of concrete counterweight partially balancing lengthwise movement is shown in foreground. Side clamp mechanism prominent at center of photograph.

The location of the unloaders is indicated in the accompanying drawing, cars being received on four tracks from the Pennsylvania R.R., crossing the tracks of the Canton R.R. immediately in front of the elevator site. This restriction imposed the necessity of extending the elevator yards from the Canton tracks to the end of the pier carrying the unloading gallery. The dumper units are located midway between the Canton tracks and the end of the pier so that sixteen loaded cars can be spotted on each of the four unloading tracks and handled without a switch engine.

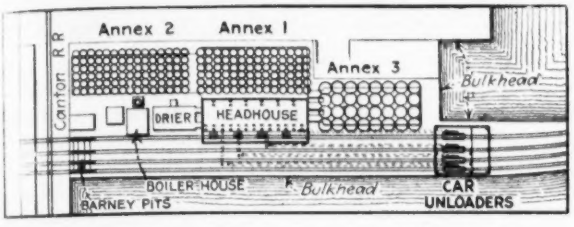


SIDE ELEVATION OF GRAIN CAR DUMPING EQUIPMENT SHOWS DEEP PIT AND HEAVY CONSTRUCTION

(A) Operator's cage. (B) End coupler clamps. (C) Side support clamp mechanism. (D) Concrete counter weight partially to balance car when tipped endwise.

A disappearing "barney" on each of the unloading tracks handles the cars to and from the dumpers, each controlled by heavy endless cables. The operator's cage on each dumper is stationed just beside the car to be unloaded, for easy observation. After the operator has spotted the foremost car on the middle of his unloader he first anchors it by the endwise and side clamps (engaging couplers and holding against the frame). The grain door is then automatically pushed in and raised, and the car slowly tipped to different positions so that its entire contents of grain is discharged into the receiving sink. Electrical connections with motors controlling the entire operation are so arranged that when the first operation is started the motors furnishing power for each succeeding operation are automatically actuated in sequence, each stopping when the cycle of operation is complete and then reversing the entire cycle of operation. As quickly as a car is spotted on the dumper, motor No. 1 is started, controlling the end clamps, which firmly engage the couplers of cars of any length. As quickly as a certain pressure is exerted by the end clamps, designated by the letter *B* in the accompanying working drawing, the power is automatically thrown out and current turned into the motors controlling the side supports marked *C*, which move up against the sill of the car, where pressure is automatically limited, with the throwing off of the current and setting in operation motor No. 3 controlling the grain door opener.

The automatic grain door opener is considered a



CAR UNLOADERS SERVE FOUR RECEIVING TRACKS

principal feature of the equipment, since it is not necessary to batter in the bottom boards and then hammer the rest of the door loose from the door posts of the car. After the bottom of the opener drops on the floor in the doorway the grain door is quickly pushed in about 6 in. and raised about the same distance from the floor of the car, sharp-pointed pins carried on upright bars on the face of the opener engaging the grain door and holding it until all grain is run out and the car has been swept. Then the opener, or pusher, is withdrawn and the temporary grain door dropped.

As soon as the grain door is pushed in, current is automatically turned into the next motor, which tips the car sidewise to an angle of 30 deg., starting the grain to flow into the hopper. Then the current is automatically transferred into the fifth motor, which tips the car endwise to an angle of 45 deg., at the same time tipping it sidewise 30 deg. The endwise tipping is then reversed so that all the grain from both ends of the car will be discharged.

Upon completion of this cycle of operation the entire cycle is automatically reversed, withdrawing the grain door pusher after the car is returned to normal position and then withdrawing the side and coupler clamps.

The dumping equipment is known as the Stewart Link-Belt Grain Car Unloader. The installation was designed and built by James Stewart & Co., contractors, Chicago, who erected the grain elevator.

Drainage of Large Railway Cuts

Abstract of report of Committee on Roadway, American Railway Engineering Association.

LONG LOW-GRADE CUTS should be avoided wherever reasonably possible in railway location, and where they are necessary the engineer should give careful study to providing adequate drainage. Such cuts should be taken out to a width that will permit of wide and deep side ditches, and the slopes should be flat enough to avoid danger of the banks sloughing. Surface ditches should be provided wherever required, and should be kept back far enough to avoid seepage or sloughing into the cuts.

Where it is not possible to accomplish drainage by open ditches, various more or less desirable schemes have been used for draining cuts, such as vitrified tiling or trenches filled with large or small rock, both tile and trench drains being used with or without lateral weepers. More drastic methods have had to be resorted to where springs have been encountered and the water seeps upward and outward from subterranean veins, these sometimes occurring directly beneath the track. Where it is necessary to put in longitudinal tile subdrains, they should be placed below the frost line and below any saturated material, laid to a true bed, and covered with cinders or other suitable material.

All water possible should be kept from reaching the roadbed. Side ditches should be provided in cuts in all or any class of material in order to hold storm water down and to convey the water away as rapidly as possible. If tile drains are still necessary, they should be placed at satisfactory depth, and the side ditches of the cut should be kept open at all times.

Heavy Timber Framing Used for Seattle Transit Shed

Latest Part of Pier B in Smith Cove Section Has Main Floor Members of 14 x 32 In. Sticks 40 Ft. Long

ON PIER 3 of the new Smith Cove development of the Port of Seattle there are two transit sheds each 128 ft. wide, separated by a 54-ft. track space and with marginal track spaces each 28 ft. 6 in., making up the total 367 ft. width. Both of these sheds are of timber framing of extremely rugged design, as shown in the accompanying drawing. A special feature is the use of twin 14 x 32 in. Oregon fir sticks, 30 and 40 ft. long, for the floor beams of the second floor. The east shed,

INTERIOR OF FIRST FLOOR OF EAST SHED, PIER B, SMITH COVE DEVELOPMENT, PORT OF SEATTLE

which is shown in the view, has been in use for some time, but the west shed, the details of which are given, is now under construction.

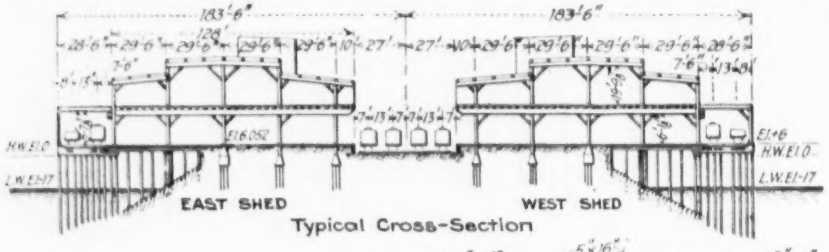
The sheds were built on a central fill with pile carried extensions on the sides. They are 1,060 ft. long, extending from the bulkhead line, where they connect with the marginal way and where the second story is connected with a marginal viaduct. The second floor girders extend beyond the wall of the first story on the track side of the building a distance of 10 ft., forming an additional 10 ft. for the second story enclosure, and providing on the first floor a sheltered loading and unloading platform the full length of the building. By thus cantilevering the second floor the necessity for columns at the outer edge of the platform on the first floor has been obviated, thereby leaving the platform entirely clear of obstructions.

Each second floor girder consists of two timbers 14 x 32 in. by 30 ft. and 40 ft. long, bolted together with an air space between. They are used because they are low in cost and can be obtained on short notice, are easily and cheaply worked into shape, and offer no difficulties to the direct attachment of connecting wooden members. Being made up of two sticks each, the members can be mated up so as to obtain for each girder greater uniformity of material and strength than is possible with single sticks, and being of wood painting as a protection against the corrosive effects of salt air is not required.

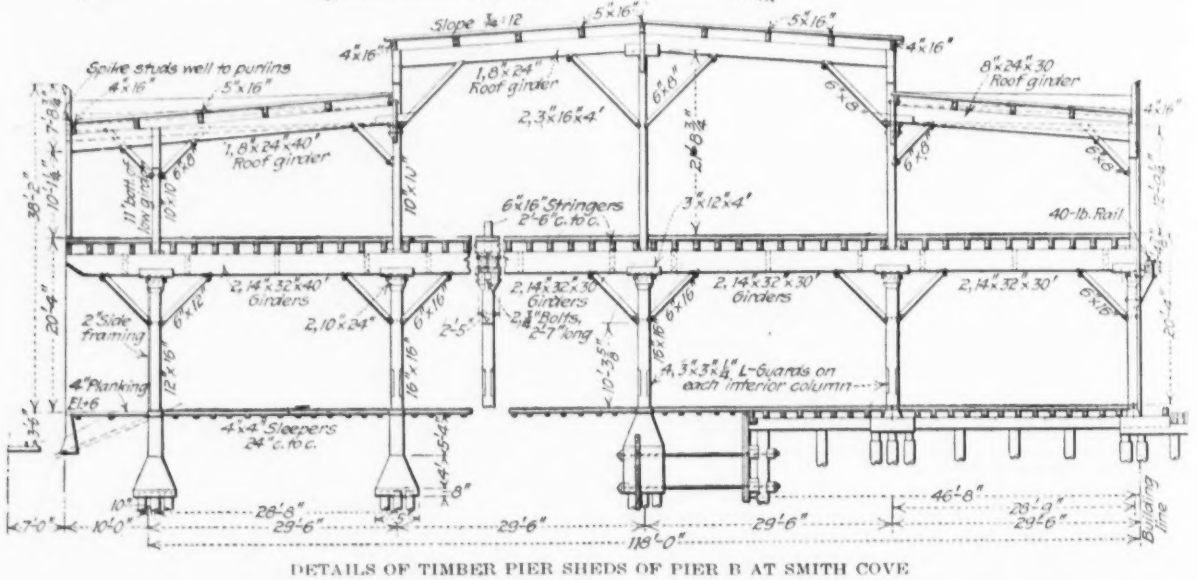
The first story column caps in the west shed are of

wood, notched into the column tops and bolted through in both directions for securing to the column and to prevent seasoning cracks. The grain of the caps is vertical. The column tops are mortised into the second floor girders to prevent collision displacements, dowels not offering equal advantages. In the east shed precast concrete column caps, as shown in the view, were used.

Columns resting on wooden pile caps, where space is available, are constructed of a rich concrete without reinforcement. Columns resting on concrete footings, which were cast at the time the pier was constructed, over one year previously, where vertical and horizontal spaces are limited and where intensities of pressure are high, have spirally reinforced concrete base plates.



Typical Cross-Section



DETAILS OF TIMBER PIER SHEDS OF PIER B AT SMITH COVE

Freight may also be handled from or to the ship at the second floor of the shed. To facilitate this a traveling freight platform has been provided to run on a track on the ship side of the building. The platform is constructed at the second floor level and travels the entire length of the shed. Passengers use the second story only, passing to and from ships by means of a traveling, adjustable gangway, which travels on the same rails as the freight handling platform. This gangway is usable at any point in the length of the shed for any size of ship or height of tide.

The piers were designed and built by the Port of Seattle Commission, George F. Nicholson, chief engineer.

Indiana Public Utilities and Water-Works

Of 1,400 public utilities of all kinds in Indiana 286 are water-works. Their value is $30,000,000 compared with $800,000,000, the value of all public utilities.

City Planning and Subdivision Plans

REGULATION of the acceptance of plans for new subdivisions is one of the difficulties in city planning work, such regulation being desirable in order to secure conformity with the adopted city plan. The purpose of such conformity is to avoid awkward and uneconomical cutting of real estate in making future street extensions or connections. The following notes on this subject are from a paper read at the recent meeting of the American City Planning Institute by Ernest P. Goodrich, consulting engineer, New York:

Except in Pennsylvania there seems to be no direct local power to prevent large or small obstructions to future development along adopted plans. Constitutional amendment is the cure, but in advance of this indirect methods of control must be employed. Municipal authorities may refuse to record streets improperly plotted, to accept jurisdiction over them, to instal paving and public utilities and to issue building permits. Influence may be exerted to induce companies to refuse loans or insure titles of lands for such obstructions.

Replotting was successsfully carried out in Portland, Ore., where all the property owners of a poorly plotted district agreed to turn over their deeds to a trust company selected jointly by the municipality and the owners, which company handled the redistribution of the area. This method not only gave back to each property owner an equivalent area but also resulted in an improved street system and in additional plotted real estate sufficient to pay for the costs of the proceeding.

In minor instances the established city plan can and should be modified to obviate such difficulties. Diagonal streets, for instance, need not be carried in absolutely straight lines. Small angles can often be introduced advantageously to reduce real estate costs and to add interest to the vista. Street extensions can be made with slight jogs, but the offset should never be so great as to produce angular crossings of other thoroughfares greater than 30 deg., because of the difficulties of traffic regulation which would be likely to follow.

Failure and Proposed Repair of Third St. Arch Bridge

Shallow Pier Foundations and Scour Blamed—Fallen Portion to Be Replaced by Reinforced Arch Ring Sections

REPORTS on the failure of the Third St. Arch Bridge in Dayton on Jan. 21, made available now by Charles H. Paul, assistant chief engineer of the Miami Conservancy District, and George F. Baker, city engineer of Dayton, agree in attributing the collapse to the shallowness of the pier foundations. In the report of Arthur E. Morgan, chief engineer to the Board of Directors of the Miami Conservancy District, the river improvement work of the district is described, so far as it lay in the immediate neighborhood of the pier that failed, and this work is declared not responsible for contributing to the failure. John L. Harrington, consulting engineer, Kansas City, reporting on the failure to the city, states that it is impossible to determine whether the river improvement operations were or were not a factor in the matter.

Mr. Harrington describes the general procedure to be adopted for repairs, which is at present about to be put under contract. He points out certain essential cautions to be observed in this work, of rather unusual engineering character. He also describes the structural conditions of the bridge arches, in which signs of deterioration are noticeable. The two reports are reproduced below in slightly condensed form.

Conservancy District Report

An examination of the pier between the spans, which is the second pier from the east side of the river, showed that a crack had occurred a little to the north of the center of the pier, that the broken part had shifted about a foot to the west and had listed to the north. The movement of this pier in all probability preceded and caused the failure of the arches.

Examination of the pier which failed showed that there had been scour around it, and that at the north point of the pier this scour had reached to about one foot greater depth than the bottom of the pier.

The Miami Conservancy District had made no excavation on either side of this pier. The nearest excavation was a shallow trench about 40 ft. to the north for the purpose of laying a water main, which was done about a year ago. The trench for this water main did not reach to a depth as great as the depth of the pier which failed and could have had no effect upon it. The work of cleaning the channel at this end of the bridge has not yet been done. This is to be done next spring.

The failure is plainly due to the shallow foundations and absence of piling under them. On all new bridges constructed on the river since the organization of the Miami Conservancy District, we have required more than twice the depth of foundation of the older bridges, and pile support in addition.

The Miami Conservancy District is in no way responsible for the failure of the bridge.

Report of John L. Harrington

The Third Street Bridge consists of seven reinforced-concrete arch spans of the Melan type, designed by Concrete Steel Engineering Co. and built by Hogland & Kline Construction Co. in 1904. It carries a roadway 42 ft. wide having two street-railway tracks in the middle, and a 10-ft. walk at each side, making a total width of 62 ft. between handrails. The spans vary in clear length from 80 ft. at the ends to 110 ft. at the middle of the bridge, with a rise of approximately one-twelfth of the span. Each is reinforced by 21 steel ribs, spaced 34 in. center to center transversely to the roadway; those in spans 2 and 3 are composed of four 2 x 3 x ⅜-in. angles. According to the plans and specifications, the concrete in the arch barrels is composed of a 1:2:4 mix; that of the piers of a 1:3:7 mix.

Pier 2 is 10 ft. wide under coping and has a footing 20 ft. wide by 80 ft. long. According to both the plans and your soundings, the pier footings are at elevation 713.13, which is 9.04 ft. below low water. The bed of the river commonly varies from nothing to 6 or 8 ft. below low water, for at this point the river bed has not yet been dredged to conform to the plans of the conservancy district.

Your soundings, made after the failure, showed the bed of the river to be washed out at the upstream end of pier 2 to elevation 711.6, approximately 1½ ft. below the pier footings. The pier broke in two approximately 31½ ft. from the upstream end and canted upstream so as to leave a crack about 9 in. in width at the coping, and toward the middle of the river about 11 in., measured at the coping. This was undoubtedly caused by the undermining of he upper end of the pier, which resulted in its failure.

The failure of the pier caused a portion of span 2, varying in width from about 24½ ft. at pier 2 to substanially nothing at pier 1, to fall almost vertically to the river bed, carrying a motor truck and a motor car with it. The fall was so direct that a considerable portion of the brick paving lay substantially intact on top of the debris. A section of span 3, varying in width from about 24½ ft. at pier 2 to substantially nothing at about three-quarters of its length from pier 2, also fell into the river. The barrels of both arches split cleanly along the third Melan arch rib, measured from the center of the bridge, for a considerable distance from pier 2, and then zig-zagged to the handrail, generally breaking longitudinally for some distance along each rib, as the break crossed it.

Each span was, during construction, divided into three parts by two longitudinal construction joints; one of these joints was crossed by the line of failure but manifestly had nothing to do with the failure itself, for the break did not follow it. Both the arch barrels and the pier show good concrete at the fractures.

The steel arch ribs are decidedly rusty. I estimate, from examination of the exposed steel, that the concrete adhered firmly to about 15 per cent of the area of the lattice bars and angles composing the ribs, thus leaving 85 per cent of the steel unprotected. Examination of all of the structure shows that this is a general condition, for from the river, the situation of each rib is clearly marked, sometimes by dripping water, always by streaks or rust, and sometimes by the scaling off of the concrete beneath the steel ribs. Each arch barrel is thus composed of alternate latticed steel girders and free and unreinforced concrete ribs.

Reconstruction Method. — The failed portion of Pier 2 should be replaced by a new portion of corresponding section supported on piles, and after it is completed the failed portion of spans 2 and 3 should be trimmed off to piers 1 and 3 and replaced with properly reinforced concrete arch barrels. The new portions of both pier and arch barrels should be well doweled to the portions remaining in place. The unbalanced thrust now on piers 1 and 3 should be reduced by removing the paving and spandrel filling from spans 1 and 4, and further by inserting struts under pressure from the renewed portion of pier 2, thus permitting the reconstruction of the failed portions of spans 2 and 3 under normal conditions.

In rebuilding the failed portion of the structure care must be taken to relieve so far as possible the stresses in the remaining portions of spans 2 and 3, for they are now carrying all of the thrust from spans 1 and 4, and care must also be taken to avoid unduly heavy blasting in the removal of the failed portion of pier 2.

Failure Conditions.—Pier 2 failed because its foundation was not carried down to a safe depth and because the water at a stage but little above extreme low water cut away the small amount of sand and gravel surrouuding it and washed out a portion of the readily removable sand from beneath it. All of the piers of this bridge are similarly

liable to failure; therefore all of the piers should be properly protected from erosion of the river bed below the elevation fixed by the conservancy district, which is only approximately 4½ ft. above the base of pier in each case.

The Miami Conservancy District surveyed the river before beginning its operations, and the results of these surveys, shown on their plans, make it clear that at the Third St. bridge the river then frequently scoured much below the elevation of river bed to which the district is dredging. It is therefore impossible to determine whether the scour at pier 2 resulted from their operations, above and below the bridge, or from some local cause of scour, for very little erosion was necessary to cause the failure, and it may have resulted from either cause.

The failure of the concrete to adhere to the arch ribs, and the consequent failure of the concrete and the steel to act as a unit, have no bearing upon the present failure, but the gradual destruction of the steel ribs by corrosion, for which I see no remedy, will limit the life of the bridge to comparatively few years. Yet the remaining years it will safely serve make it advisable to repair the present damage and to protect all the piers from scour, which may at any time cause failure of a pier or of the whole structure.

It is difficult to estimate closely the cost of repairing spans 2 and 3 and Pier 2, because the amount of work is small in proportion to the equipment required, but I estimate that $60,000 will probably cover the cost of this work.

I have carefully considered the various methods of protecting the piers against scour, and have concluded that the most economical and satisfactory will be to surround them with riprap to a width of about 15 ft. The sand and gravel must be removed so that the rip rap will have its surface at elevation of river bed fixed by the conservancy district, leaving a clear channel in accordance with their plans, yet be adequate in depth and arrangement to constitute a reliable protection. I estimate that this will cost between $20,000 and $25,000 for the Third St. bridge piers. An accurate estimate is not possible because I have not available the price of rock delivered.

Design of Railway Car Repair Shops

Abstract of report of committee on Shops and Locomotive Terminals, American Railway Engineering Association.

MANY railroad companies find it desirable to provide shops for handling repairs to freight cars either on account of climatic conditions, legal requirements or the belief that the provision of such shops will result in a higher degree of efficiency. Each railroad company must determine in accordance with its own operating methods and conditions whether a shop is justified and what expenditure is warranted, so that the fixed charges per car, due to this expenditure, may not exceed the advantages secured by better workmanship, lower unit cost and less delay in conducting repairs. The layout of many plants has been governed by existing property and trackage limits, and this condition will probably be encountered even more seriously in the future, except where very extensive plants in new localities are contemplated.

Sheds or shops are not to be recommended for light repair work, because of the frequent switching necessary and of the fact that many hundreds of cars in this class are worked upon each day. In the case of heavy repairs, however, shops may be desirable at certain points, especially when considered in conjunction with the power, tool and handling equipment necessary for intensive production.

Heavy repairs may be classed as follows: (1) Medium repairs, consisting of moderate attention to trucks, underframes and superstructure, with entire repainting; (2) heavy repairs occasioned by severe wreck damage or extreme deterioration; (3) rebuilding, where cars are strengthened and made modern in construction through the application of steel underframes, ends, roof, etc. Most railroads prefer to do heavy repair work on their own cars, due to having suitable standard material and to the fact that cars can be segregated by series and the work standardized. Where a railroad owns a sufficient number of steel cars to justify the expense, a special shop should be given consideration.

Tracks should be spaced 24 ft. c. to c. where material tracks are employed and 18 ft. as a minimum where material tracks are not used. For such spacing it is desirable to allow 60 ft. per car. Railroads using wider track centers, such as 30 ft. with material tracks and 22 ft. without, usually employ only 50 ft. per car.

For supply tracks, standard gage seems to be preferred throughout the country, due to the ease in handling wheels and the usual design of section push car upon which material can be carried. Further, erecting shops can be supplied with freight car loads of underframes, sills and other heavy material, which is not possible with narrow-gage tracks.

There should be a minimum clearance of 10 ft. from center of track to face of pilasters and 12 ft. from center of track to face of wall. Overhead clearance above top of rail where cranes are not employed should be 20 ft. minimum, 22 ft. being desirable. Where cranes are used, the clearance should be not less than 25 ft., unless careful study of local operating conditions should dictate a smaller dimension advisable. Clearance defines the exact headroom possible either from the crane hook or crane cage or girder, whichever forms the farthest downward projection. Shops designed with cranes should be limited to include bays not exceeding four repair tracks.

End doors in car shops should be not less than 13 ft. wide and 17 ft. high, obtaining as large a door on supply tracks as clearance and general construction will permit. Separate paint shop accommodation should be provided in line with the normal movement of cars through shops, being so installed that equipment can be handled expeditiously and prevent blocking repair tracks.

Full consideration should be given to expected increases in demand and to future extensions which can be foreseen. Where shops are constructed with traveling cranes, the runways should be advanced beyond the covered space to provide for flexibility of operation to permit men to work either out-doors or in-doors as local conditions may govern. This plan will assist also in the handling of material and the adjustment of loads in cars. For a prompt and ecomonic handling of material there should be cranes, hoists, monorails, supply tracks, runways and storage space, all located with a view to concentrating work and materials into definite groups.

Ample lighting is essential. Roof and walls should be so constructed as to admit the maximum amount of natural light and ample artificial light should be provided, equivalent to that required in locomotive shops. Interior walls and ceilings should be painted and maintained as nearly white as possible. A temperature of between 40 and 50 deg. F. should be maintained in the shop, but 60 to 70 deg. is preferable in adjacent machine sections and other points requiring operators to remain stationary at tools. The expense permissible in providing a heating plant will be governed largely by the form of construction to be employed. It should be remembered that during cold weather equipment has to be thawed out when brought into the shop in order to facilitate repairs, so that the heat should be delivered as near the floor as practicable and well distributed so as to avoid drafts.

New Tests on Bond Resistance

Results of the investigations made for the Emergency Fleet Corporation during the war on the possible corrosion of embedded steel and the effect on bond resistance of various methods of treatment are reported upon in Technologic Paper No. 173 of the Bureau of Standards by W. A. Slater, F. E. Richart and G. E. Scofield. The outline of these tests has been reported at various other times. The full statement has nowhere before been made available. The tests comprise tests with bars treated to prevent corrosion, investigation of individual protective coatings in their relation to bond, effect of variations and conditions of storage, comparison of plain and deformed bars, effect of the manner of applying coatings, and effect of lap.

Antioch Wins Injunction in Suit Over Brackish Water

THE town of Antioch, Cal., which is located on the tidal reaches of the San Joaquin River, has been granted a temporary injunction by the superior court of Alameda County, forbidding irrigators to divert water from the Sacramento River above Antioch on the grounds (1) that Antioch has unquestionable right to take 500,000 gal. of fresh water per day from the river for municipal uses, and (2) that water drawn from the upper river for irrigation uses was at least a contributing cause in rendering the Antioch supply unfit for domestic use in 1920. However, the court warned all concerned that the issue of the temporary injunction to protect rights which seemed to be endangered must not be construed as in any way indicating the action of the court when the suit came to be tried on its merits. The prayer for the injunction named specifically irrigation districts, companies and individuals owning about 450,000 acres of agricultural land in the upper Sacramento Valley. The case is reported to foreshadow still more important suits that may be filed by owners of large areas of irrigable delta lands who claim that the use of brackish water for irrigation will damage their land. Throughout the controversy the current question has been, "Can up-river irrigators be held responsible for the brackish condition of river water?" A summary of local conditions and of the testimony follows:

WATER NETWORK IN THE VICINITY OF ANTIOCH, CAL.

Antioch, which has a population of 1,940, pumps its water supply from the San Joaquin River. The Sacramento River, supplying 80 per cent of the combined flow of the two rivers, affects conditions at Antioch through sloughs connecting the two streams in the delta lands above the town (see map). In the lower reaches of both rivers the tidal effect is strong. In the upper end of Suisun Bay there is at times a tidal range of 7 ft. At a 6-ft. range about 80,000 acre-ft. of bay water flows upstream into the mouths of the rivers and it is the salt in this bay water that causes the complaint.

Upper Suisun Bay is fresh through winter and spring when the rivers are high. In the summer the water grows brackish, the salt content increasing up to the end of the low-water season. There is a wide variation in the annual discharge of these two streams. In 38 years it has ranged from 40 to about 265 per cent of the normal. The maximum salt content at Antioch, as determined by the State Water Commission during the latter part of August and September, 1920, ranged from 0.75 to 0.9 parts per hundred at low tide up to 1 to 1.2 parts per hundred at high tide.

Court Proceedings

In the court proceedings Antioch attempted to establish its riparian rights and to show that these took precedence over the rights of all appropriators on the Sacramento or San Joaquin rivers; that it is entitled to a certain amount of pure water and that upstream appropriators by diverting fresh water and causing salt water to flow in are as guilty of polluting the water as though they placed salt in the river.

The defense claimed (1) that the taking of water out of the river did not constitute pollution; (2) that the riparian rights of Antioch were dependent on its ownership of 0.46 acres of land which could not be irrigated because of its use as a site for pumping and filtration plants; (3) that a town in its corporate capacity cannot function as a riparian owner; (4) that water pumped from the river by a pumping plant located on riparian land cannot be taken and used for domestic or other purposes on land which is non-riparian to the river, except as an appropriation of the water; (5) that Antioch, as an appropriator, has no rights in excess of 500,000 gal. of water per day and cannot claim the entire low-water flow of the Sacramento River to keep the water fresh at its pumping plant; (6) that the maintenance of the entire low-water flow of the Sacramento River to supply that amount of water to Antioch would not be the highest use to which this water could be put.

By its expert testimony, Antioch attempted to show that the salinity of water at its intake depended directly on the flow in the Sacramento River at Sacramento and that a continuous flow of 3,500 sec.-ft. at Sacramento would be necessary to keep the water fresh at Antioch.

Experts for the defense essayed to show that several causes had contributed to salinity at Antioch in recent years. These were (1) the succession of dry years from 1916 to 1920; (2) government dredging in the river between 1913 and 1920, which had modified the tidal flow in the lower rivers, increased the circulation of water around Sherman Island and hence contributed to salinity of water flowing through three-mile slough; (3) the withdrawal of large overflow basins on Sacramento River through reclamation, thereby reducing the retarding effect on river flow and causing the river to reach its lowest stage earlier than under original conditions.

The defense admitted that the use of water for irrigation purposes was a contributing cause but contended that for the other reasons cited the conditions in the low-water season of 1919-1920 were such that even if the injunction sought had been made operative in July, and a flow of 3,500 sec.-ft. had been maintained at Sacramento, the water would not have been fresh at Antioch until winter rains came, and meantime the defendants would have suffered the loss of their crops.

A Modernized Plant to Handle Asphaltic Oils for Road Use

THE equipment for handling asphaltic oil in the San Jose yard of the California Highway Commission has recently been entirely rebuilt in order to make radical changes in the design and method of operation. The old plant was up to date when built, presumably, because it was designed by a company whose business was the handling of asphaltic materials. However, in the light of the commission's experience in recent years in handling oil for road use, it was possible to improve practically every important feature of the old plant. The time of both heating and pumping was greatly reduced, the fuel cost was cut 50 per cent, the necessary labor force was cut about 90 per cent, the very serious danger of fire was largely eliminated and it is now said to be almost impossible for the oil to "freeze up" in the pipe and pumps.

Fire Hazard in Old Plant

In the old plant, oil was pumped from the tank cars to vats. Before the pumping could commence, however, a car had to be steamed sometimes as much as sixteen hours, and not infrequently five days were required to complete the unloading. Wood fires were built under the vats to heat the oil before delivery and these fires had to be watched carefully to prevent the oil from boiling over, which was liable to set the plant on fire, as the hot oil overflowed directly into the fire pit. The pipes were often drained to prevent the "freezing," but there was no place to drain the piping system except onto the surface of the yard. This meant waste, nuisance and fire danger.

In laying out the new system provision was made for a gravity flow from tank cars on a spur track in the yard to underground concrete tanks. Three underground tanks, each with a capacity equal to that of two tank cars, were built. The pipes through which the oil flows from the tank cars each contain a small steam pipe for heating purposes so that as soon as steam is turned on, the valve in the tank car is opened and oil begins to flow almost immediately. With this arrangement it ordinarily takes only about 7½ hours to steam and empty a car. The pipes through which oil is delivered from the underground tanks were run on an upgrade so that as soon as the pumps are stopped the hot oil in the piping system drains back into the tanks. These pipes were insulated with asbestos to conserve the heat.

Underground Tanks

The underground tanks each have two small and two large compartments. By means of interconnecting gates, all the compartments can be utilized as a single container, or the gates in the partitions may be closed and the separate compartments used independently. Steam coils are provided in the smaller tanks and when the oil is to be drawn out they are heated first. As soon as the steam coils have brought the oil to a temperature at which it can be pumped, it is drawn out and circulated through a small retort. For a while the hot oil is returned to the small compartment until all the oil in this compartment is brought to a high temperature. The hot oil is then turned into the larger compartment whence it is circulated through the retort until the temperature throughout this compartment reaches the desired point and the oil is ready for delivery.

Thus, the only equipment required, in addition to tanks and piping systems, is a steam-driven, centrifugal pump for drawing oil out of the underground tanks, and an oil-burning retort for heating it. The retort is of the standard type and has a circulating system of 3-in. pipes, which is the same size as the delivery line for the underground tanks. The retort has a brick setting and is located alongside the underground tanks. The pump, protected by a galvanized-iron housing, is set on the pipe line between tanks and retort. Steam for the pump is provided from the central boiler plant built to supply the heat and power requirements of the yard.

Instead of a crew of four men, which was formerly necessary to handle the pumping system, the work now required is easily done by the fireman and the plant engineer. This consists chiefly of making the pipe connections to the tank car, starting the oil fire in the retort, starting up the oil pump, etc. With the new system, oil in the underground tanks can be brought to a temperature ready for delivery within four hours, or approximately one-sixth the time required with the old plant.

An Estimate of Hoover

THERE have been thousands of estimates of Herbert Hoover published in American and foreign newspapers and magazines, but the following, from the *New Republic* of March 9, indicates a grasp of Hoover's engineering characteristics that is not often found in the general press:

In the way he accepted his post in the cabinet, Mr. Hoover again displayed a hint of that quality which makes him easily the most constructive man in American public life. For no sooner was it admitted that Mr. Harding had invited Mr. Hoover than the evidences of Mr. Hoover thinking of what could be made of the job were seen. Of all the cabinet choices he alone, and he immediately, did the thing which is both remarkable and obvious: he showed that he was studying his opportunity and using his imagination upon it.

In our time there has been no one with quite such an appetite and such digestion for concrete fact joined to quite such a faculty for using knowledge as the basis of power. Contrast him with the man who always starts with a moral maxim; contrast him with the man who starts in some corner of the facts and ends among the wishes of interested friends. The contrast supplies a notion of the type of man who in the complicated novelties of modern civilization is needed to administer great affairs.

There seems to have gone into the making of Hoover several strains often enough found in different men, but rarely in the same one. The first of these, and the least common, is a habit of scientific estimate, an ability to think quantitatively, an ability, not only to let the facts speak for themselves, but to make them speak. A second strain, common enough by itself, but rare in a scientifically trained man, is that of the shrewd and daring trader. The story of Mr. Hoover's dealings with suspicious governments before we entered the war, and since the armistice, is a record of incredible resource and ingenuity. He plays his whole hand for all that it is worth.

But all of this would not alone have given Mr. Hoover his extraordinary place in modern life. Back of it is a gift for seeing the human reality in a true order of values. In 1914 there were plenty of people who wanted to save Belgium, yet without the Belgian relief it is possible that Belgium would have been torn to tatters in the process. The idea of saving the people that you are out to save by saving them, feeding them, sustaining them, holding them together, even though they are on the other side of the battle-line was one of those direct and unheard of performances that are a mark of genius.

American Railway Engineering Association Convention

Rail Situation Explained—Improvement in Track Labor Conditions Needed—Capacity of Old Bridges—Electrification—Wider Use of Standards

RAIL SPECIFICATIONS, the track labor problem and proposed rules for rating the capacity of existting bridges were the high points of discussion at the 22d annual convention of the American Railway Engineering Association, held at Chicago March 15-17. The interesting feature of the rail situation was a statement explaining the present deadlock due to the refusal of the mills to accept the new A. R. E. A. specifications. The other two subjects developed extensive and controversial discussion. Apart from these subjects the proceedings were largely uneventful, characterized by limited discussion in adopting specifications and other material for revision of the *Manual*, together with the acceptance of a large amount of information on a variety of subjects. This result may have been due in part to the overpowering effect of the mass of material submitted by 25 committees, nearly all of which dealt with four or five subjects, the reports for the convention covering approximately 1,000 printed pages. A news report of the convention appears in the news section of this issue. A summary of the technical discussions follows.

Deadlock in Rail Specifications

An important development of the meeting was a letter sent by the chairman of the committee on Rail, G. J. Ray (D., L. & W. R. R.) supplementing the committee's report. Mr. Ray, who was unable to be present, stated that no rails have yet been rolled to the specifications adopted in 1920 owing to the action of the manufacturers, who will not accept these specifications for rails of more than 110 lb. per yard and will only meet them for rails of less weight subject to certain modifications and an extra price. Mr. Ray believes that some of the claims of the manufacturers are reasonable, but on the other hand they have offered no constructive criticism of the specification. Their general attitude is that their own specifications and the 1915 specifications of the Association are satisfactory, that the 1920 changes will prove costly without improving the quality of the rail and that railways are not sufficiently interested in furnishing better rails to pay the extra cost of production. No action was taken or requested, but the committee this year will consider whether to adopt two specifications (for different grades of rail) or to adopt a single specification which will not require extra cost but will be accompanied by a list of specific requirements and their probable cost, for the benefit of railways requiring rails of higher grade.

As to the specifications in use, C. W. Gennett, Jr., (R. W. Hunt & Co.) estimated that those of the manufacturers represented the largest proportion of the 1920 tonnage, with the A. R. E. A. specifications of 1915 ranking second. In 1920 mills were slow to adopt special means of securing sounder ingots. Rails from the tops of ingots average 15 per cent of the production. They are all under suspicion but their price is the same as that of the others. Increase of distance between supports in the cold straightening press from 42 in. to 60 in. at some mills has given favorable results, due to reducing the punishment of the rails in this process.

The relation of shattered steel in fissured rails to the mill end of the rail was discussed by M. H. Wickhorst, and there was a report by P. H. Dudley (N. Y. Central) showing good ductility in the heads of old rails. Forms for reports of rail fractures were submitted by the committee and were adopted after some discussion as to making them clear to section foremen.

Supplementing a progress report on stresses in track Prof. A. N. Talbot outlined some later results obtained on curves. There is a high bending stress in the inner rail at the third or fourth driving wheel, though this decreases as speed increases. Lateral bending in the outer rail is found at the leading truck and first driver and at the last driver and trailing wheel, which stress increases with the speed. Tests are now being made to determine the transmission of stresses through the splice bars at rail joints.

Economics of Track Labor

It is thought that the committee on Economics of Railway Track Labor lost an opportunity when it made a good report but failed to present any definite conclusion for adoption, as evidenced by the prolonged and vigorous discussion of the subject. In the committee's opinion the railways and the engineers have not observed the lessons of the past few years and have taken no action towards overcoming the economic conditions which result in serious labor shortage each year. Intermittent work with alternate hiring and firing of forces and the continual training of green men is still common practice. Little has been done in the direction of permanent employment for skilled men over the entire year.

Standard methods of maintenance-of-way work should be considered first, in the opinion of Earl Stimson (Baltimore & Ohio). He thought that the committee had put the cart before the horse in leaving this subject for the future. This view was controverted at once and with emphasis, the general opinion being that the committee was right in first studying how to get and keep the men. It was stated by C. H. Stein (Central of New Jersey) that the labor question in these days is a psychological as well as a financial and an economic problem. Stress was laid upon the necessity of permanent employment. How can loyalty or interest be expected from men who know that they are engaged only for seasonal work and that they are likely to be discharged at any time. C. A. Morse (Rock Island Lines) showed that some part of track work requires skilled labor, although the railroads have never gotten beyond the point of considering that every man who works on a section gang is a common laborer. The skilled track labor at least should be retained permanently. Further, Mr. Morse suggested that foremen of track, water service, signal and bridge and building gangs should be trained in the habit of planning their work in advance.

In this connection the committee on Track reported that little maintenance-of-way work is now handled under contract or piecework. The Pennsylvania R.R. and Baltimore & Ohio R.R. had track work systems which included the establishment of unit performance

for piecework schedules, but these systems were abandoned by the U. S. Railroad Administration and have not been re-established. Many roads have employed a cost-plus form of contract in handling maintenance work during the past year, but in effect this was little more than the recognition of the contractor as a labor agent, the work being, as usual, under the direction of the regular railway officers. Published comparisons of the effective work of individuals or groups were suggested by the committee on Economics of Railway Operation as a means of stimulating friendly rivalry and thus increasing the efficiency of maintenance-of-way employees.

Other economic subjects were passed with little attention after the labor discussion noted above. The committee on Economics of Railway Location reported on train resistance and a comparison of electric and steam locomotives. The committee on Economics of Railway Operation discussed the subject of determining and increasing the traffic capacity of a railway and the effect of speed of trains on cost of operation. The latter subject was divided into three parts, dealing with track maintenance work, maintenance cost and transportation cost. All were progress reports and no conclusions were presented.

Capacity Rating of Old Bridges

Rules and unit stresses for the rating of existing bridges were presented as the principal subject of the report of the committee on Iron and Steel Structures. In the prolonged discussion several speakers objected to the rating stress of 20,000 lb. permitted for structures of wrought iron and bessemer steel as being too high for old structures. Although supporting this objection C. F. Loweth (C., M. & St. P.) stated that in many cases he had been obliged to carry old bridges in service where the stresses were fully as high as those permitted by this report. In such cases the type and weight of locomotives has been restricted, but there is always the tendency to assume that the structure is safe and then to forget about it. Owing to the time which elapses between the decision to renew a bridge and the actual construction of the new bridge the old structure may be kept in service without proper regard to the margin of safety decided upon at the time of inspection.

Mr. Loweth proposed that a lower stress be specified, with the provision that a higher figure might be allowed in structures which can be kept under close supervision. Such action was opposed by G. H. Tinker (N. Y. Central), who urged understanding that the unit stress specified is a limit which may not be exceeded. It was pointed out by B. R. Leffler (N. Y. Central) that the proposed rules are not intended to give the idea that any bridge is safe if its stresses do not exceed those specified. They are for the guidance of experienced bridge engineers who will keep watch of the structures in accordance with the conditions discovered. Mr. Loweth also agreed that the rules should make it plain that the bridges are under suspicion and require frequent examination, and that the relatively high stresses permitted are for structures intended for early renewal. As to the final action in ordering renewal P. B. Motley (Canadian Pacific) stated that this responsibility must fall upon some one man of sufficiently strong personality to compel renewals, where proper, in spite of objections on the score of cost.

Use of the extensometer in determining the stresses in old bridges was endorsed both by Mr. Motley and Mr. Robbins (Interstate Commerce Commission). Mr. Robbins has found that in many members actual stresses exceeded those determined by computation. Professor Wilson (University of Illinois) considered that weakening of bridges is due to the working loose of connections rather than to the deterioration of metal in the members. Tests have shown that repetition of stresses will loosen the rivets in connections where the stress is only half that permitted by the A. R. E. A. specifications for bridge design. In reply to this Mr. Tinker remarked that reversal of stress is not likely to occur except at points where it has been provided for. Where the stress is always in one direction it may be repeated so many times without causing loosening of the rivets that it may be allowed to approach closer to the full elastic limit.

Railway Electrification

The subject of steam railway electrification was dealt with directly and indirectly in two or three reports. The committee on Electricity suggested that steam auxiliaries may be necessary with hydro-electric plants, as thirty-three out of fifty-three large hydro-electric installations east of the Mississippi River are thus augmented, mainly to care for the dry season. Electric interference with telephone and other lines was also discussed. On the basis of experience with electric traction on the Norfolk & Western R.R. the committee concludes that 44,000 volt current for transmission and 11,000 volt single-phase current for the trolley line are practicable for lines having heavy grades and heavy traffic, and that probably this system will effect a saving of at least 12 per cent of the total annual expense as compared with steam operation.

Electrification cannot be undertaken wholesale, according to the committee on Economics of Railway Location, partly because of the enormous capital outlay and partly because each road or even each subdivision is a problem in itself. On the other hand, within the past few years the efficiency of the modern steam locomotive has been increased about 50 per cent by improvements which have increased the tractive power and the sustained hauling power, as well as the economy in fuel and water. Profits from electrification must be realized indirectly in a majority of cases, as in increased track capacity or the postponing of second track.

Earthwork Shrinkage

For shrinkage of earth removed from excavation to embankment an allowance of 10 per cent of quantities measured in excavation was adopted. The words "measured in excavation" were added to the conclusion as presented by the committee on Roadway, as it was shown in the discussion that the embankment quantity is sometimes taken as the basis. For swell of rock it was concluded that local conditions must be used as a guide, no general figure being applicable. According to a new definition adopted shrinkage is "the difference in volume between the material excavated and the ultimate volume of the same material in the embankment after it has reached a state of equilibrium."

Settlement is denoted as "the reduction in height of an embankment caused by shrinkage or subsidence." The committee's report supported the comparatively recent idea that subsidence occurs under all embankments except those on rock, but stated that serious subsidence is local, so that no rule can be given for estimating it.

With the adoption of standard specifications for ties, submitted by the committee on Ties in form practically identical with those adopted in January by the National Tie Producers' Association, it is considered that a long step has been taken in the efficient use of timber for this purpose. Investigation has shown, however, that no railways are using the earlier A. R. E. A. specifications. The need for supervision of committees to prevent overlapping work, with perhaps conflicting results, was evident when it was pointed out in the discussion that the committee on Wooden Bridges had also submitted independent specifications for ties. In regard to the economic values of different sizes the tie committee has found varying opinions but little definite knowledge. It considers that the difficult factor of traffic must receive more attention before comparisons or conclusions can be made. The report concluded with the usual review of substitute ties and urged that railways should provide adequate facilities for extensive tests of such ties. In the report of the committee on Wood Preservation it was stated that ties treated with water-gas tar have given good results and that further trial is advisable. Tests with sodium chloride are also desirable, in view of the possibility of this material being obtainable at a price very nearly that of zinc chloride.

Plans and specifications for switches and frogs, submitted by the committee on Track, were adopted after brief discussion. The design for a clamped frog was specially commended by J. L. Campbell (El Paso & Southwestern). The value of a lengthy report on gages and flangeway widths for curved crossings was disputed, as locomotives have such extreme variations in length of wheelbase and gage of driving wheels that no reliable conclusions can be drawn. It was suggested that the mechanical section of the American Railway Association should be asked to try to effect some uniformity in this matter. It was remarked also that curved crossings are bad in practice, but to this it was replied that frogs on curved track introduced the same conditions. It appears that the Association's standards on flangeways and curve gage are not followed in practice.

Track Tool Standards

Standardization of ballasting tools was proposed by the committee on Ballast, which submitted drawings and specifications for tamping bars, tamping picks, forks and shovels. No action was taken. The introduction of these designs depends upon both the railways and the manufacturers, but the latter have shown little interest as none of them replied to the committee's request for discussion of the proposed designs. Standard designs for track tools were adopted several years ago by the Roadmasters Association but they were used only to a very limited extent.

Other subjects covered in the report are specifications for stone and ground ballast, instructions for ballasting operated lines and the organization of a ballast raising gang of 77 men. According to the report opinion generally is strongly opposed to ballasting by contract in normal times, and especially on operated work. Concrete slabs under the ballast on soft roadbed are considered to prove successful at reasonable expense. The specifications were adopted with little discussion. For washed gravel they limited the sand to 15 to 20 per cent. J. E. Willoughby (Atlantic Coast Line) thought that a higher proportion of sand might be used, but the committee considered 20 per cent sufficient for average conditions. It would be inclined rather to lower the minimum than to raise the maximum.

Temporary signal protection for track work or emergency conditions was outlined by the committee on Signals and Interlocking. Present specifications for galvanized wire fencing are to be omitted from the *Manual*, on recommendation of the committee on Signs, Fences and Crossings, on the ground that they are inconsistent. Several roadway signs were adopted, having sheet iron targets on boiler tube posts set in concrete, but why a sign of the same type for valuation sections should have a cast-iron target the committee could not explain in the absence of one of its members. It was suggested, however, that it might be considered of a more permanent character than the others. Designs for concrete mile posts (triangular section) and property posts (rectangular) were adopted. A summary of legislative requirements as to highway grade crossings and separation of grades was submitted with the report.

Bridges and Masonry

As a preliminary to preparing standard designs for timber trestles the committee on Wooden Bridges and Trestles suggested that the E-45 loading is a minimum, E-55 generally sufficient and E-65 the maximum for which a practicable trestle can be designed with the kinds of wood generally available. A 12-ft. span or panel length was recommended, as 16-in. stringers will be available without undue cost as long as yellow pine timber lasts, but 18-in. stringers for longer spans are doubtful. The proposed loadings were objected to by E. A. Frink (Seaboard Air Line), who considered that they should conform to those of specifications for steel bridges. He also questioned the economy of 16-in. stringers. Specifications and classification and grading rules for lumber were adopted after a discussion which related to the advisability of adoption rather than to any specific criticisms.

Slump tests for concrete noted by the committee on masonry were objected to by A. F. Robinson (A., T. & S. F.), who thought they would be unsatisfactory unless made by an expert. What is needed is a set of rules that can be carried out by any intelligent foreman. Further, more attention needs to be given to the time of mixing. Another important matter is the care of fresh concrete after it has been placed. In arid districts concrete dries out rapidly and is usually not so good as that in more humid districts. Mr. Robinson proposes to try coating the concrete with some waterproofing material which will retain the moisture and permit complete hydration of the cement. According to the report of the committee concrete exposed to moisture will continue to increase in strength for some years, but if exposed to dry air there will be little gain. It was announced by the chairman, J. J. Yates (Central of New Jersey) that the joint committee on specifications for concrete and reinforced concrete expects to issue a draft of its specifications in May.

Electrolytic effect on reinforced concrete was discussed briefly by the committee on Electricity, which reported in favor of a waterproof shell, as this will not only exclude moisture but also prevent abrasion of the concrete. A waterproof pitch which will remain flexible is the best lining for the shell and samples of such material have been found elastic after twelve years' experience.

Intensive use of freight house sites on costly land or in congested districts by placing tracks on two floors and providing upper floors for warehouse purposes was recommended by the committee on Yards and Terminals. Improved handling of freight at freight houses has been mainly in the use of tractors as conveyors. Trolley hoists, having fixed paths, are better adapted to warehouse than to freight house service. Plans were submitted, and adopted, for typical track layouts and ladder tracks at passenger stations.

Methods of ascertaining the cost of new construction for buildings of different types were presented by the committee on Buildings, the price per cubic foot being considered satisfactory for estimating for a number of buildings of similar type. Standard specifications for railway buildings were submitted but no action was taken. The new committee on Shops and Terminals submitted a progress report on the design of car shops, with plans of existing shops. It presented also an illustrated classification of railway ashpits.

STANDARDS, RECORDS AND ORGANIZATION

In a progress report the committee on Standardization, which is composed of the chairmen of the several committees, pointed out that an important phase of its work is to secure the more general use of the standards, specifications and recommendations of the Association. It suggested that each committee should be requested to recommend subjects for standards. As a preliminary to a study of the presentation of engineering data in diagram or graphic form the committee on Records and Accounts submitted a 12-page bibliography. Rules for the guidance of engineering field parties and instructions for maintenance-of-way employees, submitted by the committee on Rules and Organization were adopted after some dispute over individual rules. As to organization, mention may be made of figures given by the committee on Economics of Track Labor for 60 railways aggregating 152,000 miles of main track. Although 75 per cent of these have the divisional system 72 per cent make an engineer or the engineering department responsible for maintenance-of-way and 65 per cent give preference to engineers in selecting division officers in charge of maintenance. Further, 50 per cent of the roadmasters and track supervisors have had engineering training.

Expanded Metal Showed Up Well in Slab Test

In the note describing the comparative tests of two slabs, one reinforced with rods, the other with expanded metal, in *Engineering News-Record*, March 10, 1921, p. 417, the data on the behavior of the slabs were transposed so as to make it appear that the expanded metal did not act as well as it actually did. The correct statement as to the behavior of the slabs is as follows: In the rod reinforced slab the first cracks were observed at 661 lb. per square foot, when the center deflection was 0.19 in.; the total load sustained was 1,245 lb. at which load the deflection was 1.055 in., and as the previous readings indicated rapidly increasing deflections it was decided not to continue the loading to complete failure. In the expanded metal slab the first cracks were observed at 713 lb. per square foot, at which point the center deflection was 0.15 in.; the total load sustained was 1,153 lb. and the deflection taken on the next to last load was 1.09 in.

Shall Corporations and Partnerships Practice Engineering?

Arguments Advanced for and Against Such Practice in Petitions Presented to the New York Legislature

(Details as to the status of this case will be found in the News Section of this issue, page 524.)

As set forth in the News Section petitions have been sent to the members of the New York Legislature for and against the provision in the present law which allows corporations and partnerships to practice engineering. The provision in question follows that of Engineering Council's model bill, and requires that the persons in such corporations and partnerships who are "in charge of the designing or supervision which constitutes such practice" must be licensed engineers.

OPPOSING ARGUMENT

The petition, sent by the American Institute of Consulting Engineers, but containing also the names of non-members of the institute, opposes practice by corporations and partnerships, and was sent to the Legislature first. The body of it, containing the reasons for the petitioners' position, is as follows:

(a) It [permission to corporations, partnerships and joint stock associations to practice] nullifies the intent of the law, in permitting groups of non-engineers, under the guise of corporations, unrestricted partnerships and joint stock associations, indirectly to do those very things that the individual non-engineer is prohibited from doing;

(b) It sanctions a practice that easily may be made an immoral one, in permitting an aggregation of individuals, in whole or part non-engineers, to serve in the dual capacity of supposedly disinterested professional advisers to a client and at the same time as self-interested financiers, sellers or contractors in the execution and supervision of the work in connection with which such professional advice is given, such sanction being diametrically opposed to the universally recognized rule that the engineer shall not be personally interested, directly or indirectly, in a company with which he has relations on behalf of his employer or client;

(c) It permits the relegation of the professional engineer in the employ of an engineering corporation or unrestricted partnership, made up in whole or part of non-engineers, to a position of anonymity or to that of the servant, relieving him of all professional responsibility to the client and placing him under the direction of those whose primary interest is a banker's or contractor's profit;

(d) It permits conditions under which a group constituted in whole or part of non-engineers, with impunity may violate the codes of ethics that have been adopted by various professional societies for the guidance of their members and for the protection of the public;

(e) It places the holder of a license issued by this state on a plane inferior to that existing in seven of the ten other states of the Union, in which licenses to practice the profession are now required and on a plane inferior to that existing in Canada;

(f) It lowers the dignity and standing of the profession of engineering by legalizing that which, in the penal law and other laws of the state, is stamped as illegal in the case of the professions of law, medicine, dentistry, veterinary surgery and nursing; and

(g) It is detrimental to the public interest in that it tends to force engineers in independent practice to abandon their purely professional work and affiliate with contracting or banking organizations, thus depriving the public of the disinterested and effective service of the men who hitherto have been chiefly responsible for the progress of the engineering art.

Favoring Argument

The petition of those favoring practice by corporations, partnerships and joint stock associations, forwarded to the Legislature by a group of representatives of corporations and partnerships, presents the following arguments in support of its position:

There has come to the attention of the undersigned members of the engineering profession practicing in this state in the form of an appeal to each member of the Senate and Assembly the March 16 petition of forty-three consulting engineers communicated by the American Institute of Consulting Engineers (whose membership is about 110) urging favorable action on Senate bill No. 147, and adverse action on Senate bill No. 147,716 recently reported out by the Judiciary Committee.

In the opinion of the deputy attorney general, asked and given at one of the hearings, the former bill would, if reported and passed, so profoundly modify the existing law as to require putting into the hands of receivers and liquidating the assets of all engineering partnerships and corporations in the state.

* * * * * *

In respect to the clauses affecting partnerships, etc., the unreported Senate bill No. 147 would reverse the "model bill" of Engineering Council, the organization consisting of representatives from the great national engineering societies comprising not less than 40,000 professional engineers of all branches throughout the United States and recently merged into the American Engineering Council of the Federated American Engineering Societies.

On Feb. 14, 1921, the executive board of the American Engineering Council, Herbert Hoover presiding, unanimously voted "that this board endorses the 'uniform law for registration of architects, engineers and land surveyors' prepared by old Engineering Council's committee."

The "model bill," after which the existing statute now on the books of this state was in general patterned, and which the petitioners would reverse, has behind it the preponderating and representative professional constituency to which we have referred, and constitutes the broadest consensus of professional opinion respecting engineering corporations and partnerships, as distinguished from the opinion represented by the small group of consulting engineers who have addressed you.

Senate bill 147,716, which we endorse and which has been reported by the committee, accords with the "model bill" in safeguarding professional engineering by expressly providing that "the person or persons carrying on the actual practice of engineering on behalf of such corporations, partnerships or joint stock corporations shall be licensed engineers."

Comparison With Law and Medicine—It is an error to assume, as the consulting engineers appear to do, that the profession of engineering is like the professions of law and medicine (including dentistry and nursing). If it were their conclusions and their point of view would to a certain extent apply.

Looked at in the large, law deals with rights, medicine with life, engineering with materials. The lawyer is an officer of the court and involved in the functions of government. A breach of legal ethics robs of justice, perhaps irretrievably, and may often be concealed. The physician is the highly confidential and intimate bedside agent upon whom health and life depend. A breach of medical ethics may cost even life and be covered by the grave. The engineer, as distinguished from the pure scientist not here involved, is invariably the servant of economics or business, and is submitted invariably to the test and the involvements of commercial cost. A breach of engineering ethics affects the purse and is extraordinarily difficult long to conceal, particularly from the criticism of fellow engineers, for the engineer's structures, machines and combinations are tangible evidences before the eyes of the world. They represent a field to a high degree less personal than the fields of law and medicine.

The ethics of engineering revolves about a different axis from the ethics of law or medicine.

Reason for Group Organization—These are reasons why engineering would receive a heavy blow if professional engineers were deprived of the right of doing their work in groups either through corporations or partnerships and forced to split up into individual practitioners.

The engineering profession has been growing by leaps and bounds. It started about 150 years ago with civil engineering. Ten years ago the number of officially recognized branches was twenty-seven. Today the Department of Education of the State of New York recognizes forty-two, among them being civil, mining, mechanical, electrical, metallurgical, illuminating, insurance, heating and ventilating, chemical, aëronautical, hydraulic, marine, refrigerating, automotive, industrial, structural—not to mention more.

A single engineer cannot in justice to the public today profess to be an expert in more than two or three of these branches at once, yet the increasing magnitude and diversity of engineering projects often involves many and sometimes a majority of the branches mentioned.

If bill No. 147 should become law, which the consulting engineers urge, the individual could not with his fellows form an engineering partnership better to cover the engineering field. If he hired professional engineers as his employees he would be committing the evil the petition cites against corporations and partnerships; namely, relegating the professional engineer "to a position of anonymity or to that of the servant."

If it be once recognized that the art of engineering has grown broader than the capacity of an individual personal practice then both in respect to technical equipment and to working capital, it will be seen that the engineering partnership and the engineering corporation, far from being evils, are necessities—opportunities enabling many thousands of engineers to co-operate with each other and with the public in a way otherwise closed to them.

The increasing number and success of the groups does not lead but follows the trend of the day. The public demands service in larger units under greater concentration of responsibility at greater efficiency of direction and accompanied by greater pecuniary responsibility than a number of separate consulting engineers could supply.

Construction Work—To cite certain abuses of engineering partnerships and corporations as possible without reference to certain abuses in individual practice as also possible does not give a balanced picture.

The individual consulting engineers further say "(g) It is detrimental to the public interest in that it tends to force engineers in independent practice to abandon their purely professional work and affiliate with contractor or banking organizations, thus depriving the public of the disinterested and effective services of the men who have hitherto been chiefly responsible for the progress of the engineering art."

The progress of the engineering art is a big thing. It is tending to rank construction a part of engineering fully as much as design. The definition written on the walls of the great national Engineering Library begins, "Engineering is the art of organizing and directing men and of * * *."

If we understand them right the individual consulting engineers regard performance of the function of construction as incompatible with "purely professional work," and a certain type of lump-sum contractor who loses business when the functions of design and construction are combined agrees with them.

But the advantages to the client (the public) in combining engineering and construction through the saving of time, of cost, and through the greater control permitted him over his project are so great that in recent years constantly increasing numbers of clients prefer to have their work thus carried out.

Where design and construction are simultaneously performed by the same engineer, partnership or corporation a much larger capital is necessary than for design alone and the affording of this capital is an additional reason for the growth of engineering partnerships and corporations.

These, for stipulated and relatively small fees, put themselves in the position of trusted agent for the client (the

public), as which agent they perform for him exactly the same services in design and construction as he would perform for himself if all the engineers and constructors were his own employees.

This comprehensive service often involves the purchase and installation for the client's account of many millions of dollars worth annually of machinery, apparatus and supplies and these purchases are business dealings requiring specialists of a very high order of commercial ability and integrity to protect the client's interest. While the client reimburses the engineer for expenditures for purchases, for payroll, etc., the working capital required to carry on the business prior to reimbursement, to furnish plant and other equipment, and to be absorbed as working capital in the form of accounts and bills receivable in the same fashion that any other business absorbs it, is large, usually reaching figures beyond the capacity of individuals and especially of professional individuals to furnish.

The possession of larger capital renders the engineering partnership or corporation much more responsible at law than the individual consulting engineer for any malpractice it may perform, or culpable error it may commit and the fact that engineering partnerships and corporations can be sued with advantage for breaches of trust, for violations of law, for carelessness and other acts render dealings with them more satsifactory than dealings with individuals of less pecuniary responsibility, while it makes for acute consciousness of liabilities.

These are reasons why industrial corporations, banks and syndicates of capitalists and investors which furnish work for the engineer are tending more and more to deal with the groups rather than with the less pecuniarily responsible although no less professionally responsible individual engineers, and we repeat that the present law, together with the reported bill which we endorse, requires of partnerships and corporations that the persons carrying on the actual practice of enginereing on their behalf must be licensed engineers.

In simultaneously performing the functions of design and of construction or in performing the function of design for one client and of construction for another, whether in the latter case the work be carried out by lump sum contract or otherwise, it is impossible to discover any serving "in the dual capacity of supposedly disinterested professional advisors to a client and at the same time as self-interested financiers, sellers or contractors in the execution and supervision of the work."

There is no impropriety in receiving a stipulated fee for construction or a stipulated fee for design, or in receiving a larger stipulated fee for a combination of both.

When doing both, the interest of the engineer, partnership or corporation is wholly identified with the interest of the client and is not opposite.

There is a skill in designing that only experience in construction can give and there is a skill in construction that only experience in designing can give, and the consulting engineer who would suppress engineering partnerships and engineering corporations and thereby withdraw the possibility of group action and of capital for a larger scale and more progressive engineering business, instead of being "chiefly responsible for the progress of the engineering art" aims a blow at one of the rapidly growing and successfully developing functions of that art—the function of construction.

Student Chapters, American Society of Civil Engineers

Student chapters of the American Society of Civil Engineers number fifteen according to the February issue of the society's *Proceedings*. The chapters are located at the following institutions: Cincinnati, Rensselaer, Drexel, Iowa State, Pennsylvania State, Rutgers, Stanford, University of Iowa, Colorado, Kentucky, Pennsylvania, Pittsburgh, Texas, Wisconsin and Washington.

Tuning Up the East Chicago Filters

DIATOMS in the supply and overload in capacity combined to make runs of the filters exceedingly short in the early operation of the filter plant at East Chicago, Ind. H. E. Jordan, superintendent of filtration, Indianapolis Water Co., in a paper presented recently to the Indiana Sanitary & Water Supply Association outlined some of the "tuning up" difficulties at this new plant put into operation Nov. 11, 1920. The plant has a nominal capacity of 8 m.g.d., operating at the rate of 125 m.g.d. per acre. The 36,000 people served had been using 300 to 360 gal. each per 24 hours of the unfiltered water. Filters were built with the understanding that meters would be set on every service. As soon as the consumers have been educated to the direct relation between waste and payment the rates will drop below the nominal capacity. In fact a drop has already been noted from 10.4 m.g.d. in December and January to 9.9 m.g.d. during the first 12 days of February.

Essential features of the plant are six 24 x 20-ft. 3-in. filters, a four-compartment sedimentation basin of 4 hours' detention period, mixing tanks comprising two units of four tanks each with horizontal baffles to give a velocity 1 to 2 sec.-ft. and nominal detention period of 4 min., a 75,000-gal. wash-water tank on the third floor of the chemical house, duplicate dry-feed chemical apparatus and three filtered water basins, two being under the filter tanks. The perforated pipe underdrains in the filters consist of 2½-in. wrought-iron laterals spaced 6 in. c. to c., with two rows of ⅜-in. perforations on the underside spaced 3 in. c. to c. The gravel depth is 16 in. and the water is maintained 4.9 ft. above the 30-in. sand layer, the surface of which when at rest is 30 in. below the wash-water gutters.

The sand size originally specified was 0.3 m.m. but was increased to 0.4 m.m. before delivery. Less than 5 per cent is of the 0.3-m.m. size. The uniformity coefficient ranges from 1.35 to 1.66. Operation has stratified the sand and several inches of 0.3-m.m. size has been scraped from the surface.

The turbidity of the water is low, less than 25 p.p.m., but diatoms, mostly asterionella, range in the daily counts from 1,000 to 2,000 standard units per cubic centimeter. To reduce the number of diatoms a gradually increased amount of aluminum sulphate has been used until it appears that not less than 200 lb. per million gallons is required to reduce the microscopic content of the effluent from the sedimentation basin to less than 300 standard units.

The average length of run has ranged from 3 hours in December to 5.2 hours in February, the corresponding overload being 30 and 23 per cent. Wash water has ranged from 16.7 to 8.2 per cent.

A more serious question, however, arises in this plant, as at others on the lower end of Lake Michigan, in that steel mill quench waters and discharges from oil refineries produce unusual and disagreeable tastes. These tastes are charged up to the chlorine or to the alum treatment by the consumer. Mr. Jordan feels that it is not the duty of the water-works company or departments of these cities to extend their purification systems, even if it were possible, to meet the peculiarities of all industrial wastes but that the industries should keep these noxious materials out of the lake.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

On Corporations Practicing Engineering

Sir—A petition has been sent to the Legislature of the State of New York protesting against an amendment of the state licensing law which would permit the practicing of engineering by corporations. [The petition appears on another page of this issue.—*Editor.*] It appears to me that the profession has arrived at the parting of the ways. Either it should courageously abandon the practices which in other professions and among common carriers are forbidden by law; or else it should cease to claim a single-minded devotion to the interests of the client or employer and frankly and without cavil acknowledge itself to be a trade or business.

On this decision would seem to rest our future attitude toward the extension of engineer license laws throughout the country. If we are to assume the obligations that attach to the other professions and bar the practice of engineering by corporations, partnerships made up in whole or part of non-engineers, and joint stock associations, then the requirement that individual engineers shall be licensed, in my judgment, is logical and proper,—otherwise not.

The professional standing of the signers to the petition would seem to entitle their opinion to the earnest consideration of your readers.

New York, Mar. 17, 1921. W. J. WILGUS.

Automatic Recorder for Stream Discharge

Sir—The use of a cam to produce a float-gage record directly indicating stream discharge, described in *Engineering News-Record*, Dec. 9, 1920, p. 1124, under the heading "An Automatic Recording Apparatus for Stream Discharge" and independently invented by Prof. Irving P. Church (*Engineering News-Record*, Dec. 30, 1920, p. 1297), is antedated by a similar device which the writer saw in use at the Barking Outfall of the London Main Drainage Works in 1913. In this discharge of effluent from the precipitation tanks passed over a weir and the volume, as determined by the Francis formula, was recorded directly on the chart. KENNETH ALLEN,

New York City, Jan. 4. Sanitary Engineer Board of Estimate.

Sir—Referring to the description of Moore's attachment described as an "Automatic Recording Apparatus for Stream Discharge" in your issue of Dec. 9, 1920, p. 1124, and to Prof. Church's letter to you concerning the same appearing in your issue of Dec. 30, 1920, p. 1297, attention is directed to U. S. patents 938,850, 946,128 and 1,103,410 covering self-registering water meters, issued to the writer in 1909, 1910 and 1914.

In all of these patents the idea of using a cam with radii proportional to the discharges of any given stream for varying gage heights to control a registering device is used. The patents cover the flow of water over weirs, through orifices and in open channels. The application of this cam control to a recording as well as to a registering device is simple and was considered by me at the time of working up my patents over ten years ago. So far as I can learn my application of the idea of using a cam for determining the flow of water is the first use of the kind.

Several instruments have been made in accordance with the patents and have been reliable and reasonably accurate.

Another interesting application of the principle involved in the discharge cam was worked out by the writer in 1914 and 1915 and submitted to the U. S. Geological Survey for test. The design consisted of a device for automatically integrating the discharge of streams in acre-feet from the graphic records of automatic gage height recorders by using the integrating apparatus from one of the instruments above referred to. In this device, hand propulsion was substituted for the usual clock-drive of the water meter and a cam based on a rating curve for the stream was cut from card-board and used to establish the relation between gage and discharge. As the gage height record was run past the integrator by means of a speed drive connected with the hand drive of the integrator so geared as to co-ordinate the time elements of the integrator and the gage record, a tracer attached to the float wheel of the integrator by means of a fine flexible wire was made to trace the gage height graph and thus through the rotation of the float wheel the corresponding discharge effects were simultaneously transmitted to the integrator arm through the cam. This device converted the long and tedious computations of stream discharge into a brief operation of only a few minutes time. The machine was used in experimental demonstrations with success in the general hydrographic conference of the Geological Survey in the winter of 1915, competition with other devices having the same purpose. F. W. HANNA,

Ankeny, Iowa, Jan. 4. Consulting Engineer.

[After seeing copies of the letters from Prof. Church and Messrs. Allen and Hanna, Mr. Moore submitted the following.—EDITOR.]

Sir—My position is unchanged as to the declaration that the Stevens recorder, as equipped with the Moore discharge plotting attachment and working on the Moore special hydrographic cross section paper, is the first automatic stream discharge recorder so far developed that is satisfactory from both scientific and commercial standpoints, and is moreover quickly adaptable to any cross-section and to any stream. It is not merely a weir-discharge measuring device, as have been most of the discharge-measurers so far developed, although it can record weir-discharge of any dimension with the utmost ease, once the weir rating curve has been developed.

Although due deference is paid to the device of Prof. Church, as developed for weirs, my invention was independently developed without any knowledge of the work of Church, Hanna, Allen et al. The claim that mine is the first universally adaptable *recorder* of stream discharge is here reiterated. It is not claimed to be an *integrator*, although no doubt this feature can be easily added when desired, or if desired, which, from his experience, the author is inclined to doubt. GEORGE HOLMES MOORE.

Olympia, Wash., Feb. 14.

[To go further in clarifying the situation, *Engineering News-Record* requested Mr. Stevens to review the subject from his viewpoint. Mr. Stevens' letter follows.—EDITOR.]

Sir—The use of a cam for converting height of water into discharge was probably first used in connection with the development of recording devices for the Venturi tube, for which latter device patent 381,373 was granted to Clemens Herschel April 17, 1888.

In 1905 patent 790,693 was granted to J. W. Ledoux of Swarthmore, Pa., for a liquid-meter applicable to the Venturi tube, in which the spiral cam is used, to cause the recorder "to show the rate of flow at any instant." It is my impression that this is antedated by other patents of recording devices for the Venturi tube.

Engineering Record, Sept. 21, 1912, p. 334, describes a device for weirs and flumes designed and used by R. G. Hosea, assistant engineer Colorado Fuel & Iron Co., wherein a spiral cam somewhat similar to that shown by Mr. Moore is interposed between the float and recording pencil to cause the pencil to record rate of flow directly instead of water levels. There is no mention of a patent. The article closes with the following: "The writer noticed an illustration of a similar device said to be in use at the Hanley, England, sewage purification plant . . ." Perhaps this is similar to the recorder mentioned as having been seen by Kenneth Allan at the Barking Outfall of the London Main Drainage Works, as noted in his letter above.

On Dec. 24, 1907, patent 874,529 was granted to H. Neibuhr, "a subject of the King of Prussia, German Empire, and a resident of Hanover, Germany," covering a "device for transforming a motion variably according to any mathematical law into a uniform motion and registering the latter, [which] can be employed in connection with gas- and water-meters." This device uses a combination of cam and link and is applicable to open channels, weirs, etc., causing the pencil to record rate of flow directly.

Mr. Hanna in his letter above makes a distinction between "recording" and "registering," according to which it appears that the Moore attachment, the Ledoux patent and the Hosea and Church devices, as well as the sewage recorder in England, would be classed as "recording" devices in that they record rates of flow. The Hanna meter and the Stevens type L recorder and flow meter would be "registering" devices in that they register total volume, not rates of flow. (The Stevens recorder and meter, described on p. 531 of this issue, is covered by patent 1,356,322, for which application was filed on July 23, 1917.)

In all such recording devices the height (or pressure) of the liquid is the independent variable h to which the rate of flow q is connected by some functional relation, for example $q = kh^n$. The transformation from h to q is therefore effected by some form of cam, one co-ordinate of which is proportional to h, while the other co-ordinate is proportional to kh^n. In the case of registering devices the total volume v is obtained by some integrating mechanism involving the element of time, such that there is produced graphically or indicated by dials the integral of q with respect to the time t or $v = \int kh^n dt$.

The use of the Hanna meter for obtaining volume in acre-feet from graphic records of gage heights is ingenious and practical, but on account of the necessity of tabulating mean daily discharge has been superseded in the offices of the U. S. Geological Survey by an instrument known as the Fuller Integrator. This instrument shows on a dial the mean discharge in second-feet when the tracing point is passed over the graphic record of gage heights for one or more days. It was first designed by Edwin S. Fuller, formerly of the U. S. Geological Survey, and has been perfected by the Water Resources Branch of that Service. It is of the registering type, but automatically divides the volume integral by the time so that mean rate of flow is obtained.

It is doubtless true and not unusual that these devices should have been perfected in various parts of the world entirely independent of each other. Mr. Moore's attachment is novel in its mechanical details but the fundamental principle has been recognized many years—in fact, it is not at all unlikely that a more exhaustive research would disclose the use of the principles involved many years prior to any citation I have made.

J. C. STEVENS,
Consulting Engineer.

Portland, Ore., Feb. 19.

Getting Rid of the Bark Beetle

Sir—Your paragraph under the title, "Insects Destroy More Timber Than Do Fires," on p. 1279 of *Engineering News-Record*. Dec. 30, 1920, should be given serious attention by engineers. Conservation of forest resources, reforestation and afforestation are problems of vital interest to the nation, and engineers must give their best efforts to the solution of these problems or be victims of their own lack of foresight.

The science of forestry is in its infancy. Even in regard to the natural phenomenon of fire in the forest there is a division of opinion as to whether fire in its normal and natural operation is detrimental or beneficial to the forest. In some types of forests, fire is admittedly a natural silvicultural agent. The yellow pine forest of Klamath and Lake Counties, Ore., mentioned in your article, is one of these. Fire is caused there mostly by lightning. Suppression of these natural fires for a long period of years, however, creates an abnormal amount of forest litter and prevents the normal and natural operation of fire as a silvicultural agent. It is also claimed that suppression of fire increases the crop of beetles, the "insects which destr more timber than do fires."

It is said that state and federal funds are insufficient f the eradication of the beetles. As now practiced, the meth of eradication is a very costly one. It consists in felli and peeling the infested tree and burning the bark. It very questionable whether this is the best and most ec nomical method. The cost of present practice is about per tree. The cost of the proposed operation of surfac firing would be less than $1 per acre and, if properly eng neered, should be less than five cents per acre.

The presence of the beetle is indicated by pinkish-colored pitch tubes protruding from the tree. The color is due t the particles of bark mixed in the white pitch. The mass of pitch, about 2 in. in diameter, has a tube through it, this tube extending through the bark forming an entrance or opening through which the mature beetle may pass. The larva develop in reservoirs of pitch between the wood and the bark and new galleries are cut in the soft formative tissue largely by the grubs.

When a pitch tube is set afire, it will continue to burn until the galleries are drained of the reservoirs of pitch. The bark which has been separated from the wood by the galleries will burn off to some extent; and, undoubtedly, the insect in its various stages of development is destroyed. This may be an effective and economical method of eradication of the beetle.

The California Forestry Committee, organized in 1920 to study and experiment with controlled burning and other forest problems, is giving close attention to the effect of fire upon the bar beetle. Engineers having any data on this subject should furnish this committee with same.

JOSEPH A. KITTS,
Civil Engineer, California Highway Commission.

Santa Monica, Cal., Jan. 22.

Foundation Difficulties in Plan of the New York-New Jersey Port Commission

Sir—The plans of the New York-New Jersey Port and Harbor Development Commission show a large transfer station in Jersey City where the freight is to be transferred across platforms, reloaded into small cars and taken to Manhattan over two tracks in tunnels. These tunnels form thereby a belt line railroad, reaching Manhattan at 47th St., and returning to New Jersey at or near the Battery.

Various routes are shown through Manhattan. One running along West St. with warehouses covering four, six and eight city blocks each, or sixty-eight city blocks in all. While this route is probably the least objectionable one after completion, it will be enormously expensive because this route lies almost entirely on made land, formerly reclaimed from the North River, and experience shows that foundations in this location encounter a mass of old piles, timber grillage and stone riprap, etc., making the work very slow and expensive to say the least.

The other plans show routes across the city to the East River and back again, and it is stated in the report that these tunnels would be put so far below the surface that they would not interfere with the future subways. But such tunnels crossing the lower part of Manhattan would probably wreck a great many buildings which are now resting on the surface of quicksand.

The routes along the East River would encounter much of the same material as along West St., as Pearl St. used to be the East River shore line, and as Greenwich St. was the North River shore line.

Another point in the commission's report is that these tunnels would be so far below the street level that they would not interfere with the subways running over them. But apparently the fact was overlooked that the warehouses, in the aggregate covering sixty-eight city blocks on one plan and forty-five city blocks on another would take one mass of very expensive column foundations and elevator foundations which would have to be carried down to the rock and would seriously interfere with any system of subways above it.

T. KENNARD THOMSON,
Consulting Engineer.

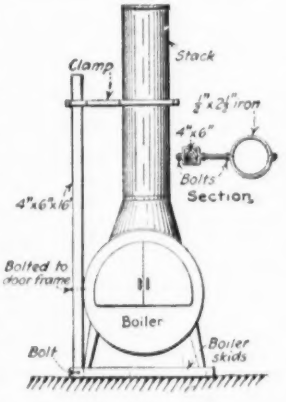
New York, March 15.

HINTS FOR THE CONTRACTOR

Timber Boiler-Stack Support for Temporary Set-Ups

BY GEORGE W. MCALPIN
Point Pleasant, West Virginia

FOR holding stacks on temporary boiler set-ups, such as are usually found on construction jobs, the support shown in the accompanying sketch has been found of great service.



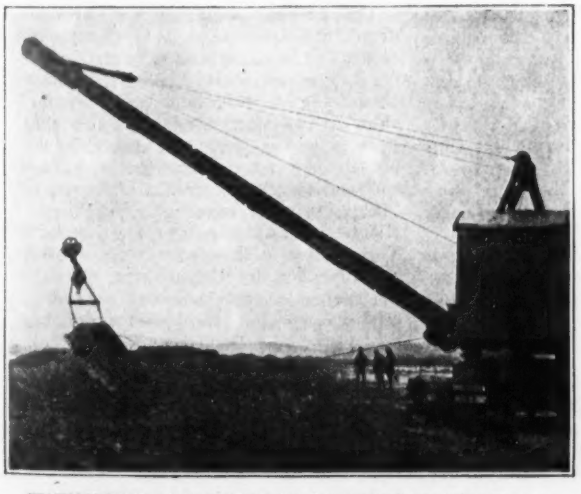
The support is composed of a vertical 4 x 6-in. or 6 x 8-in. post, bolted to the boiler base and having, at its upper end, an iron clamp encircling and holding the stack. The clamp is quickly and easily adjusted by bolts and fastened around the stack as it is set up in position. The support is rigid, does not obstruct as do guy wires, is cheaply constructed and easily erected.

Closed-Drain Excavation in Irrigation Work Done by Dragline

BY JAMES D. HAYS
Hays, Sloan & Lewis, Inc., Engineers, Boise, Idaho

MANY drainage districts in the irrigated sections are small and have combined open and closed systems. The only machine to use for the open drain is, of course, the dragline. However, we have found that for trenching in tile work the dragline compares favorably with the trenching machine, and it eliminates the additional expense incurred in the use of a second machine, for the dragline as well can be used in back filling.

On a job on which this system was used near Payette, Idaho, during 1920 the tile crew, working nine hours, could lay as many lineal feet of tile as the small dragline could dig in three 8-hr. shifts. The banks were sloped in accordance with tile conditions, so that working conditions were made safe for the men.



TRENCHING AND BACKFILLING DONE BY DRAGLINE

In backfilling a regular bucket was used, but the dump line was detached, as is indicated in the accompanying photograph. Backfilling was accomplished at about twice the speed of excavation, cutting cost in half.

Five men constituted the tile gang, and two men handled the dragline, with a general superintendent over all. Team work was intermittent. From 500 ft. to 700 ft. of trench could be opened and tile laid in a day. M. R. Lewis was in charge for the firm.

Bridge Sway Reduced by New Flooring

REPLACING a 3-in. plank floor by wood block on 4-in. tongue-and-grooved plank resulted in remarkable stiffening of the intercounty bridge over the Monongahela River connecting Webster and Donora, Pa. The bridge, built in 1908, comprises five pin-connected spans (one of 515 ft., among the longest highway truss spans in the United States), totaling 1,288 ft., with 258½ ft. additional of deck girder approaches, and has a 24-ft. roadway carrying two street-car tracks. It was floored with 3-in. oak decking on 6 x 6-in. ties, 2 ft. on centers, carried by four longitudinal joists. Autotruck traffic and heavy coal haulage from adjoining mines made the maintenance cost of this floor very heavy, there being almost daily floor failures and the cost for lumber alone amounting to $3,200 per year during the last four years. The floor of the truss spans has therefore been replaced with a 3¾-in. creosoted wood block pavement on a 4-in. base of tongue-and-grooved planks, supported by ties spaced 18 in. on centers and that of the approach spans by hillside brick on concrete arches sprung between transverse 6-in. I-beams spaced 2 ft. on centers. William G. Muse, road engineer for Westmoreland County, under whose plans and specifications the work was done, says of the work that it has "entirely remedied the excessive vibration and side swaying so marked in both the trusses and girders with the old oak decking carrying the traffic.

In connection with the floor repair the roller nests of the five truss spans were cleaned and packed in grease to insure their free working, as an additional remedy to the vibration under traffic. This called for a special expedient in the case of the 515-ft. span, where the weight per shoe amounted to 300 tons and there was no possibility of making an inside connection to the 6-in. end pin. A 9-in. machined collar was run onto either end of the pin, and inserted in two 15½ x 2-in. plate hangers engaging a 15 x 6-in. steel jacking beam above, which was lifted by two 300-ton hydraulic jacks. All lifting contact surfaces were faced with sheet lead. Lifting a shoe, removing the roller nests and putting in blocking, took less than 8 min. This work as well as the floor renewal was done by the Farris Engineering Co., Pittsburgh. The total cost of the bridge improvement amounted to about $60,000, of which $6,200 was the cost of jacking up the spans and cleaning and replacing the rollers.

NEWS OF THE WEEK

New York, March 24, 1921

Railway Engineers Meet in Annual Convention

Members Act on 18 of 25 Committee Reports Presented — Attendance Largest in Association's History

All previous records of attendance were broken at the twenty-second annual convention of the American Railway Engineering Association in Chicago, March 15-17, when 650 members, or 16 per cent more than last year's record, and 160 guests registered. At practically every one of the six sessions the convention hall was filled to capacity, beginning with the opening meeting to hear the annual address of the president, H. R. Safford. Reports of 25 committees were submitted and action was taken on 18 of them. Everything had been printed in advance, permitting the chairman or some member of the committee, all of whom sit with him on the "witness stand," to present the findings in the briefest time. Almost without exception the committees gained approval for material which they recommended for the *Manual*. A report of the technical discussions appears elsewhere in this issue.

Discussions were not voluminous, that on allowable stresses in the rating of old bridges being the most spirited. Some objection was raised to the slump test for concrete consistency and a report on comparative advantages and disadvantages of electrification of steam roads brought out opposing opinion as to the operating difficulties in bad weather. Neither was there a unanimity of opinion on the proposal to take membership in the American Engineering Standards Committee. Prominent among the recommendations adopted were specifications, classification and grading rules for timber and conclusions as to disintegration of concrete and the corrosion of reinforcing steel in sea water.

President's Address

In the presidential address, Mr. Safford called attention to a better era which he believes has arrived for the railroads coincident with the passage of the new Transportation Act, closing a period of excessive regulation and failure of the public to realize the interdependence and joint responsibility of the railroad and user to create, support and maintain what the public most desires—good transportation. To committee personnel problems, said Mr. Safford, much time has been given. He recommended a joint conference between the committee of the board on personnel and the various committee chairmen at the beginning and end of the year to perfect the committee or-

524 *(Continued on p. 526)*

Engineering Practice by Corporations and Partnerships at Issue in New York

Societies Pass Resolutions and Both Sides Address Statements to Members of Legislature

(For arguments on the merits of this controversy see page 518 of this issue)

A protest against permitting corporations, unrestricted partnerships and joint stock associations to practice engineering in New York State was made by the New York Section of the American Society of Civil Engineers at its meeting March 16, when it adopted without a dissenting vote a resolution offered by Colonel William J. Wilgus calling on the Governor and the Legislature to act favorably on Senate bill 147, amending the existing licensing law passed last May. This action followed the reading of a petition, signed by a number of prominent New York engineers, objecting to the practice of engineering by corporations and unrestricted partnerships. Bill 147 would repeal the clause in the existing law permitting corporations and partnerships to practice engineering.

The New York Chapter of the American Association of Engineers passed resolutions of similar purport March 8, as did the Council of the American Institute of Consulting Engineers March 9. The former organization explained in forwarding its resolution to the Senate Judiciary Committee that its representatives at hearings Feb. 21 and 22 (referred to below) had taken a contrary position, in the belief that the fate of the licensing act was at stake. This delegation, however, had gone to Albany to support the repealing amendment.

Since the hearings of Feb. 21 and 22 both the opponents and the advocates of practice by corporations have addressed petitions to the members of the Legislature supporting their respective views, the petition of those who oppose corporate and partnership practice, forwarded by the American Institute of Consulting Engineers, contains the names of forty-one (originally forty-three) signers, most of them being prominent consulting engineers. This petition dated March 16, was sent first. The second petition aiming to offset that of the consulting engineers, was handled by representatives of corporations and partnerships and was forwarded to the Legislature this week. Count of the total number of signers was not available as this issue went to press, but on Tuesday morning had passed the 400 mark.

Development of Controversy

The present situation was brought about by the introduction in the Senate Jan. 24 of an amendment to the licensing law which would repeal the clause permitting corporations and partnerships to practice. Under the law that permission is granted "provided the person or persons connected with such corporation or partnership in charge of the designing or supervision which constitutes such practice is or are licensed." This clause is in accord with the bill recommended by Engineering Council.

Hearing on the proposed amending bill was held before the examining board and the Department of Education, which administers the law, on Feb. 21, at which were present representatives of the American Association of Engineers, of several other engineering societies and of engineering corporations and partnerships. As a result of discussion it was agreed to abandon the

Another Dayton Bridge in Danger

Reporting on an inspection of the Dayton View bridge over the Miami River at Dayton, O., J. L. Harrington has advised the city commission that one pier of the bridge is being slowly undermined and is in danger of washing out at any time. Closing the bridge to traffic is being considered. One pier of the Main St. bridge is also said by Mr. Harrington to be in unsatisfactory condition.

Two Legislative Houses Pass New York Port Treaty Bills

The Senate of New Jersey and the Assembly of New York have passed bills authorizing the negotiation of a treaty between the two states looking to a program for developing the Port of New York and providing for the creation of a port authority of six members, as recommended by the New York-New Jersey Port and Harbor Development Commission. The measure is favored by Governor Miller of New York and opposed by Governor Edwards of New Jersey.

At this writing the New York State bill is "on general orders" in the Senate, from which it will pass to a vote after a third reading. Early passage and approval by the Governor are looked for at Albany. At Trenton the measure has largely become a party issue, opposed by the Democratic Governor. Since Republican members predominate in both houses, passage of the bill over the Governor's veto is now expected.

request for repeal, but to substitute for the clause permitting corporations and partnerships to practice one that the attorney-general's representative believed would be in better legal form. The original amending bill is known as No. 147, and the substitute bill, which would allow the existing law in substance to remain unchanged, is known as No. 147,716. Consulting engineers practicing as individuals are the chief advocates of the former bill, while representatives of corporations and partnerships are leading in the support of the latter.

The following day, Feb. 22, a hearing on the amending bill was held before the Senate Judiciary Committee, and a spokesman, selected by the preceding day's meeting, urged upon the committee the passage of bill 147,716, which, as above stated, would, in effect, leave the law unchanged. It is alleged in the petition favoring bill 147 that the time of the hearing on Feb. 22 was advanced from 2 p.m. to 12 noon, and that therefore those favoring it arrived after the hearing adjourned. The petition advocating No. 147,716, however, submits copy of the original call for the hearing as evidence that the hour originally set was noon, while against their opponents' claim that only "those favoring the corporate interests" were heard they cite a list of engineers not connected with corporations or partnerships who were present at the hearings.

The petition supporting No. 147 also alleges that that bill was prepared "at the instance" of the licensing board and of the Department of Education. This apparently is correct, but the opposing petition points out that three of the five members of the licensing board and the representative of the Department of Education after hearing the discussion on Feb. 21 abandoned their support of No. 147 and joined in support of No. 147,716. The opposing petition suggests that it is possible that some of the petitioners favoring No. 147 may have signed that petition in the belief that they were endorsing a bill which continued to have the support of the licensing board and the Department of Education.

The bodies of the petitions argue the merits of the case and will be found on p. 518 of this issue.

Financing Decatur Water Co.

A few hours after the signing of the contract, March 7, between the city of Decatur, Ill., and a newly incorporated water company, bankers subscribed $500,000 and citizens $300,000 to finance the enterprise. About $1,000,000 is needed to acquire the site of an impounding reservoir, to clear the flooded area and to remove the roads and bridges. This amount was beyond the statutory debt limit of the city, as explained in *Engineering News-Record*, Feb. 17, p. 299. The dam to form the reservoir is now under construction, with J. Albert Holmes as resident engineer, representing Pearse, Greeley & Hansen, consulting engineers.

Pier Washout Wrecks Bridge

A 75-ft. steel bridge over Bald Eagle Creek, near Bellefonte, Pa., was wrecked on March 13 by failure of the south pier as the result of a washout. The bridge had been repaired only a year ago.

Engineer License Bills Progress

In Missouri, Senate Bill 11 to license architects, professional engineers, and land surveyors has passed the state senate and is now before the house. In New Jersey, the license bill is out of committee and ready for second reading. In North Carolina, the bill introduced in the legislature at the instance of the North Carolina Assembly of the American Association of Engineers has been passed by the senate and house.

Elevated Trafficways Proposed for New York City Vehicles

In continuance of its policy of discussing topics of major engineering interest in the metropolitan district the New York Section of the American Society of Civil Engineers at its meeting March 16 dealt with the subject of streets and parks. Charles W. Leavitt opened the discussion with a paper suggesting the relief of traffic congestion by the construction of a number of north and south trafficways to be cut through existing blocks of buildings and to be carried on elevated structures, except at Central Park, where vehicle tunnels were proposed.

In the matter of parks Mr. Leavitt presented statistics showing that New York City is deficient as compared with other municipalities. For Greater New York there is only one acre of park per 699 inhabitants as compared with the following population per acre of park area for other cities: Minneapolis, 100; Washington, 124; Boston, 245; St. Louis, 302, and Chicago, 700.

The paper was dicussed by Arnold W. Brunner, president of the Fine Arts Federation; Colonel F. S. Greene, former state commissioner of highways; Jay Downer, of the Bronx Parkway Commission; Amos Schaeffer, consulting engineer, Borough of Manhattan; Palmer Campbell, Hudson County, N. J., park commissioner; Charles Whiting Baker, Palisades Park Commission, and George B. Ford, consultant to the New York City Planning Commission.

Mr. Schaeffer in emphasizing the need for a more intensive use of existing streets before new ones are built, presented a cost analysis of the project outlined by Mr. Leavitt which indicated a grand total for the construction of the expressways, grading and paving the lower level of the new avenues and cost of land between $1,375,000,000 and $1,800,000,000.

Mr. Ford made a plea for the co-ordination of city planning by adjacent municipalities and outlined the work now under way in France whereby the plans of individual cities are passed on by a departmental board, which in turn reports to a central national planning commission.

Water Filtration Recommended for Buffalo, N. Y.

A mechanical water filtration plant for Buffalo, N. Y., with a rated capacity of 160 m.g.d. has been recommended by George C. Andrews, water commissioner, and George W. Fuller, consulting engineer, New York City, in a report sent to the City Council on March 16. A. W. Kreinheder, city commissioner in charge of public works, has recommended that the City Council authorize the Bureau of Water to prepare plans for the proposed filter plant so that contracts may be let by February, 1922. Mr. Kreinheder also recommends that land adjacent to the Ward St. pumping station be reserved for a filter plant of an ultimate capacity sufficient to serve 1,000,000 people. A public hearing on the proposed filter plant will be held on March 29.

Cost Estimated

The estimated cost of the proposed 160-m.g.d. filter plant is $4,000,000 without considering the development required by the Park Department, under whose jurisdiction is the land proposed for the site of the filters. The operating expenses of the filter plant are estimated of $120,000 a year, but it is stated that with a saving in pumping costs due to the elimination of needless waste, lower prices for fuel for pumping and with increased sales of water due to new consumers, it is probable that by 1925 Buffalo may be able to enjoy the benefits of water filtration without any increase over its present water rates—or, at most, an increase of not more than 5 to 10 per cent. Some six months ago a new rate schedule was adopted which it is expected will provide added income of about $600,000 a year—needed to meet increased operating costs and to provide a sinking fund for bond retirement.

Spring Valley Asks Rate Increase To Extend Water-Works

A substantial increase in water rates is asked for by the Spring Valley Water Co., San Francisco, in an application now pending before the Railroad Commission of California. The petition lists proposed improvements estimated to cost $15,000,000. To secure a loan for these improvements, the company urges that an increase in rates, which will pay interest on the loan, is necessary.

The improvements include $10,000,000 for a pipe-line around the southern end of San Francciso Bay to bring water from the Calaveras Valley into the city. This item is opposed by the city on the ground that it would be an unnecessary duplication of the aqueduct planned by the municipality to deliver water from the Hetch Hetchy supply. In reply, the company states that the Hetch Hetchy conduit crossing the bay at Dumbarton will reach the city at El. 240, whereas the Calaveras line, coming around the bay at a higher level, will deliver water at El. 400.

Railway Engineers Convention

(*Continued from p. 524*)

ganization. Corresponding members of committees were also recommended. Curtailment of volume of material without sacrifice of value is much desired. Because of the increasing complication of many questions he advocates more experimental work and less dependence on personal viewpoints. Mr. Safford made note of the association joining Engineering Council and the inexpediency, on account of the financial burden and objectionable plan of organization, of becoming a charter member of the Federated American Engineering Societies. He was of the opinion that, if it appears desirable and financially possible to become a member of the latter, action should be by referendum vote. Of the new problems, those having to do with economics are the most vital in his opinion because of the different relative values arising from the existing wage schedules and working conditions.

Finances

Financially the association has been able to maintain its work without increase of dues or making an inroad into its reserve funds, the receipts, $37,631.37, being only $755.18 less than the disbursements. Ten numbers of the *Bulletin* and the 1920 *Proceedings* with 1,500 pages, 50 per cent in excess of last year, have been printed. Publication of the revised *Manual* has been deferred to include the important changes of this convention. It will then contain in its 1,000 pages the net results of the organization for 22 years.

The membership campaign initiated in January, 1920, netted 521 applications. The total new enrollment March 1 was 195. A net increase of 313 for the fiscal year.

At the annual dinner Dr. David Kinley, president, University of Illinois, spoke of the common fields of the association and the university. William Renwick Riddell, Justice of the Supreme Court of Ontario, gave a stirring address on Canada and the ties that bind the English peoples together. John F. Wallace, first president of the association, in outlining the origin of the organization, indicated that the framers of the constitution felt that the preparation of scientific papers without direction was a waste of time; a program of investigation must be blocked out. Out of this idea grew the plan of standing committees covering the whole range of railway engineering work.

New Officers

The officers elected for the ensuing year by the formal balloting are as follows: President, L. A. Downs; vice-president and general manager, Central of Georgia Ry.; vice-president, E. H. Lee, vice-president and general manager, Chicago & Western Indiana R.R.; treasurer, G. H. Bremner, district engineer, Bureau of Valuation, Interstate Commerce Commission; secretary, E. H. Fritch; new directors, C. F. W. Felt, G. J. Ray, and Col. G. H. Webb. J. L. Campbell, chief engineer, El Paso & Southwestern System, is the vice-president who's term continues. The new nominating committee is as follows: J. R. W. Ambrose, R. H. Ford, E. A. Hadley, J. V. Neubert and A. F. Robinson.

New President of American Railway Engineering Association

Lawrence A. Downs, vice-president and general manager, Central of Georgia Ry., and the newly elected president of the American Railway Engineering Association was born in Greencastle, Ind., in 1872 and was graduated from Purdue University in 1894. He

LAWRENCE A. DOWNS

entered railroad service in February, 1895, with the Vandalia R.R. From 1896 to 1898 he was in the engineering department of the Illinois Central R.R. and for nine years following was road master on the Amboy, Louisville, Louisiana, Springfield and Chicago divisions. From 1907 to December, 1910, he was assistant chief engineer, maintenance of way of the Illinois Central. In December, 1910, he became division superintendent of the Iowa division and later of the Minnesota and Kentucky divisions of the Illinois Central. In January, 1915, he was made general superintendent, Southern Lines, and in August, 1916, general superintendent of the Northern Lines of the Illinois Central.

On Jan. 1, 1919, he became assistant general manager of the Illinois Central R.R. and on Mar. 1, 1920, was appointed vice-president and general manager, Central of Georgia Ry.

Favor Engineering Department

After having failed of passage at the Feb. 28 session, the Humrichouser house bill, in the Indiana Assembly, creating a department of engineering under the jurisdiction of the state conservation commission, was passed by a vote of 65 to 18 in the house March 3.

Government Engineers Discuss Their Status

Subjects discussed by the 100 delegates to the convention of the Federal department of the American Association of Engineers, Feb. 28, Mar. 1 and 2 in Washington, D. C., included reclassification of government employees, federal-aid on highways, changes in Federal department rules, retirement, the Interstate Commerce and Civil Service commissions and the merit system of promotion.

Indiana Favors Interstate Harbor

The project for an interstate lake harbor, to be located at a site called "Illiana" on the Illinois-Indiana state line, has been approved by the Indiana legislature. A bill passed March 4 provides for the creation of an interstate commission and appropriates $25,000 for its work. A similar bill is before the Illinois legislature. This project has been proposed by Col. W. V. Judson, U. S. Engineers, as described in *Engineering News-Record* of Jan. 20, p. 120.

Report on Rincon Hill Regrade Project in San Francisco

Final data on the proposed regrading of Rincon Hill in San Francisco have been compiled, an assessment district prepared, and the change-of-grade ordinance approved, according to the annual report of the Bureau of Engineering in that city, just issued. This project contemplates the removal of 3,000,000 cu.yd. of soft rock and clay which "has long been a barrier to transportation between the business section of the city and the manufacturing and waterfront area south of Market St." Rincon Hill covers an area of 85 acres and has a summit elevation of 110 ft. The land is privately owned and is held in 309 parcels. Most of the district is practically waste land due to the excessive grades, and for the most part is occupied only by scattered second-class residences.

It is proposed to cut down the hill so that the maximum grades will not exceed 3½ per cent, and to widen and pave the streets traversing the area. The best available site for dumping the material is said to be in the Islais Creek district, about 3 or 3½ miles from the hill. The deepest cut to be made would be 89 ft. and the total cost of the work is estimated at about $4,000,000. At present the land on top of the hill is estimated as worth $1 per square foot, while land around the foot of the hill is worth $4 per square foot.

The removal of the hill will, according to the report, "not only provide direct routes for transportation, but will so rapidly enhance property values in the district itself that regrading the section will prove no burden on the owners of the land affected nor in the proposed assessment district." It is estimated that the contemplated work will take about 18 months after construction starts.

Federation Opens Offices in Washington

With the opening of its suite of offices in the National Savings and Trust Company Building, in Washington, the Federated American Engineering Societies will direct its work in the future from the national capital. L. W. Wallace, executive secretary of the organization, has been in Washington completing the arrangements for the opening of the national headquarters. He will not be able, however, to take up his residence in Washington for another month. In the meantime, the offices will be in charge of A. C. Oliphant, assistant secretary.

The principal effort being made at this time at the offices of the federated societies is in connection with the extension of the employment service of the organization. In addition to having one central office, the plan is to have branch offices in several of the larger cities. A full report on the employment service is to be made when the executive board meets in Philadelphia on April 16. Secretary Hoover, of the Department of Commerce, president of the federation, expects to attend the executive board meeting. At this meeting, a comprehensive report also is to be made on the activities looking to the establishment of a department of public works.

Copies of a model bill for the licensing of engineers are available at the office of the executive secretary. These bills are being sent out to those interested, not with the idea of offering a recommendation one way or the other in the matter but in the hope that any state legislation which may be enacted will follow the general lines of the model bill, which is the result of extended study.

Plan More Effective Co-ordination of Railroad Facilities

A plan for advanced methods in conducting railroad transportation which, it is stated, will produce far-reaching results, will insure annual savings of millions of dollars, increase facilities and service, and lower railroad fares and rates, was submitted March 21 to Senator A. B. Cummins, chairman of the Senate Committee on Interstate Commerce. These plans are presented in a printed statement issued by S. Davies Warfield, president of the National Association of Owners of Railroad Securities, accompanied by numerous exhibits. In a separate letter to Senator Cummins Mr. Warfield points out that unless intensive economical methods in railroad administration are adopted there is no alternative but government operation, followed by government ownership, although the country has given overwhelming evidence of being opposed to it. Representatives of the association will later appear before the Senate committee to formally present the plan in further detail. Senator Cummins has announced his intention to ask Congress to authorize an investigation into the causes of the unsatisfactory conditions of the railroads.

Mr. Warfield's statement takes the position that fundamentally new methods are obligatory, that wage adjustments must accompany and be part of the general program of intensive economies, many of which cannot be made effective by individual railroad systems handicapped by existing lack of co-ordination, and asserts that the present voluntary agencies are necessarily inadequate. It deals with equipment, financing, purchases, and operations, and would require the managements of the railroads to put into effect a new organization of the railway machine in the United States without waiting for the consolidations now being tentatively worked out by the commission.

New Jersey Cities and Towns Discuss Water Shortage

Water problems common to Plainfield, Elizabeth and twenty other New Jersey communities supplied by the Elizabethtown, Plainfield-Union and Middlesex water companies were discussed at a conference held at Plainfield March 10. The companies named have announced that there is danger of a water famine unless more water is made available and that they are unable to finance needed enlargements unless the cities and companies join in some means of relief. The meeting voted to ascertain the desirability and cost of a physical and financial examination of the properties of the companies. All but four of the twenty-two municipalities agreed to this decision. M. S. Ackerman, member of the City Council and head of the Water Commission of Plainfield, N. J., was chairman of the temporary organization effected at the meeting.

Standard Oil Valuation Made

What is said to be one of the most extensive valuations of industrial property made has just been completed for the Standard Oil Co. of California by Ford, Bacon & Davis, engineers, New York City. The work, which was performed under the direction of K. A. Harvie, manager of the western division of the valuation department, was completed in eight months. The work consisted of a minute examination of oil-producing fields, manufacturing plants, and all properties owned by the Standard Oil Co. of California located in Pacific Coast states, Alaska and the Hawaiian Islands. It is understood that the property involved aggregates approximately a half billion dollars in value. About 200 engineers were engaged in the valuation work.

New York Water-Power Bill

Following the Governor's message noted in these columns last week there has been introduced in the New York Legislature a bill creating a state water-power commission which would control all water power in the state under provisions somewhat similar to the Federal water-power act.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, Boston; Convention, Cleveland, June 6-10.

The Seattle (Wash.) Section, Am. Soc. C. E., at its meeting Feb. 28, was addressed by A. H. Dimock on "The Swan Lake Impounding Reservoir."

The American Institute of Electrical Engineers, at its Board of Directors meeting held in New York, March 11 heard the report of the Committee of Tellers of its canvass of the nomination ballots cast for candidates for the Institute offices becoming vacant July 31, 1921. William McClellan of Philadelphia, Pa. was nominated for president.

PERSONAL NOTES

NORMAN S. SPRAGUE, city engineer, Pittsburgh, Pa., has been dismissed by Mayor Babcock. The removal is generally believed to be part of a political situation that is likely to involve the resignation of several other city officials.

E. G. HARTFORD, assistant engineer, has been appointed office engineer Boston & Albany R.R., with headquarters at South Station, Boston.

WINTHROP E. NIGHTINGALE has been elected assistant professor of civil engineering Northeastern College and will assume the position of acting director of engineering practice on April 9.

JOSEPH MENDELSSOHN, civil engineer and architect, formerly designer of theatrical buildings for G. W. Lamb, theatrical architect, has joined the staff of George and Edward Blum, architects, New York, as structural engineer.

R. S. MOORE of Brooklyn, N. Y., has been appointed an assistant engineer on the Hudson River vehicular tunnel project in New York.

EUGENE T. CRANCH has been appointed city sanitary engineer of Petersburg, Va.

CRAIG P. HAZELET has been appointed instructor in structural engineering in the College of Engineering, University of Illinois.

HERBERT J. GILKEY has been appointed research assistant in theoretical and applied mechanics, College of Engineering, University of Illinois. He has had wide experience in surveying and mapping with the state engineer of Oregon and with the U. S. Geological Survey in Oregon and California. He was in charge of the map and drafting department of the American Relief Administration under Herbert Hoover at Paris headquarters from February to August, 1919. Since 1919 he has been structural engineer for the Lord Engineering Co., Chicago.

CHARLES W. ERISMAN has resigned from the Pennsylvania State Highway Department and has opened engineering offices in Lancaster, Pa., to engage in highway consultation and engineering, roads, streets, bridges, contractor's reports and estimates, farm and land surveys and drafting.

WILLIAM SNAITH has resigned as chief draftsman of the Riordon Co., Ltd., Mattawa, Ont., to accept a position on the technical staff of the Forest Products Engineering Corp., Chicago, Ill.

J. A. GORR, formerly division engineer, Shreveport division, Louisiana lines of the Southern Pacific, has been appointed division engineer of the Lafayette division, Lafayette, La.

FRANCIS W. BLACKFORD, civil and mining engineer, will sail for Bolivia, South America, April 2 to locate a railway line and to do other engineering work.

THERON M. RIPLEY has been reinstated as division engineer, New York State Highway Department, by Herbert S. Sisson, highway commissioner, and will have charge of the division office at Hornell, N. Y.

PERRY FILKIN, formerly division engineer, New York State Highway Department at Hornell, N. Y., has been transferred to the Buffalo division.

SQUIRE E. FITCH, who has been serving as division engineer in the Buffalo division office, New York State Highway Department since the death of C. J. McDonough in December, will return to his former position as superintendent of maintenance in the western half of the state.

L. R. SHELLENBERGER, structural engineer, until recently connected with Dwight P. Robinson & Co., New York, in the structural department, has opened offices in New York City as a consulting engineer. Special attention will be given steel frame buildings, reinforced concrete and foundations.

CHARLES ANDROS, for the past twelve years senior assistant in the New York State Highway Department, has taken a position in the United States Patent Office at Washington, D. C.

H. H. CHAPMAN, formerly assistant engineer of tests, has been appointed engineer of tests of the Atchison, Topeka & Santa Fé Ry., with headquarters at Topeka, Kan.

GEORGE P. MCLAREN, formerly engineer of the Ontario district, Canadian National Rys., has been appointed engineer maintenance of way, Eastern Lines.

R. L. PEARSON, formerly division engineer, New London and New Haven divisions, New York, New Haven & Hartford R.R., has been appointed maintenance engineer, Lines West.

E. R. LEWIS, formerly editor of the "Maintenance of Way Cyclopedia," has been appointed office engineer of the Michigan Central with headquarters at Detroit, Mich.

OBITUARY

CAPTAIN DAVID W. PAYNE, U. S. A., retired, died March 5 in Brooklyn. He was born in Corning, N. Y., in 1843 and was graduated from the U. S. Military Academy at West Point in 1865, when he entered the Corps of Engineers. While in the army he designed and built the first dredge boat used on the Mississippi. At the close of the Civil War he cleared the wrecks of the Confederate ships at the mouth of the Mississippi. In 1869 he resigned from the army to engage in foundry and machine shop work with his father, founder of the firm of B. W. Payne & Sons, manufacturers of steam engines and boilers, at Corning and Elmira, N. Y. He was the inventor of a number of improvements in steam engines, including the Payne automatic governor and the shaft-governed Corliss engine. He was engaged in a number of experiments in the development of machinery for making beet sugar, and during the early 80's developed ice machines, Wood's hydraulic riveters and presses, Tabor moulding machines, and the first Diesel engines built in this country, also armour piercing and cast iron projectiles for the navy. He was the editor of *Steam* and the author of Payne's "Handbook on Foundry Practice."

FRANCOIS HENNEBIQUE, the celebrated French reinforced-concrete engineer, died in Paris on March 7, 1921, at the age of 79 years. M. Hennebique was one of the earliest engineers in any country to apply reinforcement to concrete and developed the system which bore his name and which has had the widest use in Europe.

ERNST J. LEDERLE, chemist and twice commissioner of health, New York City, died March 7. He was born on Staten Island, N. Y., in 1865, and was graduated from the School of Mines, Columbia University, in 1886, from which institution he received the degree of Ph.D. 1895 and D.Sc. 1904. After serving in the Department of Health, New York City, first as assistant chemist and then as chemist, Dr. Lederle was named commissioner of health by Mayor Low and served from 1902 to 1904. He then established the Lederle Laboratories, New York City. Subsequently he became consulting sanitary engineer of the Board of Water Supply, New York City, and a member of the New York State Water Supply Commission. These positions, with their salaries of $10,000 and $5,000 a year, he gave up to become health commissioner of New York City again, at $7,500 a year, under Mayor Gaynor.

ALBERT H. WOLF, consulting engineer, Chicago, died March 13 in Atlantic City at the age of 66. He started his engineering career with the Chicago, Rock Island & Pacific Ry., which he left in 1875 to enter the U. S. Lighthouse Bureau, where he designed several lighthouses on the Atlantic Coast. In 1881, after four years' study at the Universities of Berlin and Strasbourg, he practiced as consulting engineer in Montana and in Philadelphia, associated in the latter place with J. H. Linville. In 1884 he opened in Chicago an office as consulting and contracting engineer. He was one of the pioneers in the development of skeleton-constructed high office buildings and is said to have been the first to use built-up columns instead of round cast-iron columns. Mr. Wolf was a member of the Western Society of Engineers.

BUSINESS NOTES

KEMPER-MCLAUGHLIN CO. is the name of a firm recently organized by Joseph Kemper, city engineer of Utica, N. Y., for four years, and A. J. McLaughlin to engage in construction work.

H. S. GREENE, director of the Barber-Greene Co., Aurora, Ill., since its organization, has been elected vice-president in charge of sales of the above company.

HOWARD H. MARSH, for nearly eight years manager of publications of the Simmons-Boardman Publishing Co., New York, at Cleveland, Ohio, has resigned to become president of the Victory Equipment Co., New Orleans, La., specializing in construction and industrial machinery.

N. B. PAYNE & CO., New York, dealers in electric cranes and hoists, have extended their lines of material handling machinery to include the portable conveyors of the A. C. Warner Co., Philadelphia, Chicago automatic coal elevators and McKinney-Harrington package pilers and car loaders. Edmund Otto is now associated with N. B. Payne & Co.

Highway Bids of New York and Ohio, Received March 18, Analyzed

Ohio Bids Show Concrete Lower Than Bituminous Types—103 Contractors Bid on 21 New York Projects

The large number of contractors bidding in New York, the comparison of concrete with other types in Ohio, and the receipt of bids so far under the engineers' estimates in both states are features noted in an analysis of the bids received by these two states on March 18.

TABLE I—ANALYSIS OF NEW YORK HIGHWAY BIDS

Miles	Number Bidders	Engineer's Estimate	Low Bid	High Bid	Low Bid in Per Cent Estimate	Per Cent increase High Bid Over Low
4.89	4	$175,011	$147,878	$169,171	84	15 0
4.35	0	162,777	No bids			0 0
5.68	3	227,287	218,858	223,330	91	2 0
5.22	1	264,376	248,110	248,110	94	0 0
5.21	4	157,007	148,010	156,979	94	6 0
6.54	0	243,277	No bids			
2.28	14	91,008	78,300	89,931	86	15 0
2.71	4	99,258	91,189	95,633	92	5 5
8.37	3	288,097	259,522	278,187	90	7 0
5.99	3	199,428	184,340	189,666	90	3 0
2.99	9	20,953	17,993	20,952	86	18 0
3.34	3	144,965	138,084	144,474	95	4 0
9.37	7	289,339	263,600	283,125	91	8 0
2.85	3	123,790	113,448	122,467	91	7 0
0.59	9	26,903	23,906	25,874	89	9 0
	9	36,742	32,673	35,449	89	9 5
3.46	1	126,739	124,651	124,651	98	0 0
0.50	14	33,835	28,669	33,515	85	18 0
7.25	3	257,776	234,042	257,297	91	10 0
5.95	6	227,286	220,462	226,533	97	3 0
5.02	3	186,368	181,496	184,779	97	2 0

In Table I is given the comparison of the bidder's price with that of the engineer's estimate on New York projects. The low-bid average is around 95 per cent of the estimate, although in a few instances the per cent drops considerably below 90. The competition in bidding is seen by the fact that on two projects there were fourteen bidders, on three others nine each, on one seven. The rest of the projects—except two on which no bids were received—drew from one to six bids each. On two projects the high bid was 18 per cent in excess of the low bid and the low bid 85 per cent of the engineer's estimate. The smaller jobs seem to be the more popular. The New York bids are for the construction of approximately 90 miles of highways of varying types.

TABLE II—ANALYSIS OF OHIO HIGHWAY BIDS

Miles	Type	Engineer's Estimate	Low Bid	Bidders Per Mile Cost	Low Bid in Per Cent of Estimate
0.93	Monolithic Brick	$ 43,431	$42,612	$46,000	98
6.19	Brick	397,896	356,325	57,500	90
	Re. concrete	317,227	267,275	43,000	84
	Bit. concrete	361,538	332,858	54,000	95
3.20	Brick	199,755	176,669	50,000	89
	Re. concrete	159,120	135,812	42,500	85
	Bit. concrete	181,331	168,805	53,000	93
1.16	Bitoslag	92,494	89,593	77,500	92
	Bitulithic		87,402	75,500	*
2.17	Bitoslag	170,879	160,118	73,500	94
	Bitulithic		160,912	74,000	*
1.85	Concrete	47,326	45,254	24,500	96
3.49	Brick		176,981	51,000	*
	Mon. Brick	179,675	176,957	51,000	98
1.21	Brick	85,536	78,233	65,000	92
0.53	Brick	19,317	18,076	36,500	94
	Sh. Asphalt	11,296	15,683	30,000	139
1.29	Brick	48,686	42,542	33,000	87
	Sh. Asphalt	29,101	38,429	30,000	131
	Concrete		61,369	37,500	*
1.63	Bit. Macad.	69,554	62,386	38,000	90
	Bituminous Macadam (†-1)		60,239	37,000	*
1.04	Bit. Macad.	40,706	34,490	33,000	85
2.26	Bit. concrete	118,924	106,724	47,000	90
	Concrete		94,853	42,000	*
5.69	Bit. Macad.	159,871	137,434	24,000	85
2.00	Mono. brick		91,952	45,000	*

The Ohio bids showed an average of $38,000 per mile for concrete, as against $48,000 for all types of brick, and $51,000 for bituminous concrete. Sheet asphalt proved the least expensive in the bids, two projects of that type averaging $30,000 per mile. These costs include grading, drainage structures and pavement. The average of seven types included in the bidding are as follows: Sheet asphalt, $30,000 per mile; bituminous macadam, $33,000; concrete, including reinforced and plain, $38,000; brick, including monolithic, brick on rolled base, vitrified brick and brick on waterbound macadam base, $48,000; bituminous concrete, $51,000; bitulithic, $75,000, and bitoslag, $75,500.

Detroit to Vote on Municipal Cement Plant

At a recent session of the city council of Detroit, action was taken to submit to the people at the April election a charter amendment authorizing the establishment by the city of a plant for the manufacture of cement, vitrified crock and sewer brick. The proposed amendment would also authorize the city to acquire sand and gravel pits.

Increase in Homebuilding Indicated

Indications of a steady increase during the spring in residential building are contained in this week's Construction News. There are a number of apartments listed among the proposals, and in contracts let the number of apartments is steadily increasing. In New York City alone contracts have been let during the past week for the construction of eight apartment houses for a total of more than $1,250,000.

Increases in the value of miscellaneous building is seen in the fact that during the first three weeks of March contracts let were three times the value of the contracts let during the first three weeks in February. Most of the buildings in this class are educational, bank and office, and theater buildings. Forty-seven miscellaneous building contracts let during the past week called for a total expenditure of $7,352,221.

Building Situation as Viewed by Federal Reserve Banks

In analyzing the reports of its member banks on building conditions during February, the Federal Reserve Board says:

"Building operations throughout the United States have declined during the past month. The reduction in the volume of construction is not, however, as great as the figures may indicate, due to the considerable fall in the prices of building materials this year from the abnormally high levels a year ago."

Reports from nine of the twelve districts are contained in the following paragraphs:

District No. 2 (New York)—Contracts awarded during January for residential building in New York State and Northern New Jersey were greater in value by about 90 per cent than in December. This represents about 40 per cent of the aggregate, as compared to 25.8 per cent in December.

District No. 3 (Philadelphia)—Thirteen large cities report January building permits valued at $1,917,548 as compared to $2,018,690 in December, and $4,939,784 in January, 1920. Decline in building activity paralleled in the lumber and brick manufacturing trades.

District No. 5 (Richmond)—Valuation of January permits decreased 5.4 per cent as compared with January, 1920. Reported that there appears to be developing a strong movement toward home construction, and various plans for bringing this highly-desired result are being put forward.

District No. 6 (Atlanta)—Appears to be considerable increase in valuation of permits issued in some of smaller towns. Practically all the larger cities show decreases. Total valuation much lower than a year ago.

District No. 8 (St. Louis)—Value of permits issued in the four chief cities during January, 1921, $1,488,804—increase over December of $915,471. Considerably under the January, 1920, valuation of $2,391,903.

District No. 9 (Minneapolis)—Number and value of permits issued decreased substantially as compared to both December and January, 1920.

District No. 10 (Kansas City)—Estimated value of January permits 48.2 per cent less than for January, 1920.

District No. 11 (Dallas)—Decrease of 58.1 per cent in value of permits issued in January, 1921, over January, 1920.

District No. 12 (San Francisco)—January, 1921, permits show a 44.2 per cent decrease in value compared to January, 1920, and a 10.3 per cent decrease in number.

The report concludes with the statement that "Lumber and other building materials, which were not affected by price readjustment as early as many other commodities, declined considerably in January but, in the case of lumber at least, were relatively stable during the first weeks of February. In fact from southern districts reports are made that there is considerable buying demand, although not enough to cause an increase in prices."

Illinois Road Bids

Analysis of the bids submitted Feb. 18 on highway work planned by the State of Illinois shows a low-bid per-mile average of single sections to be $32,233.25, and of combination bids, $33,215.40. Add to these figures the cost of cement—about $7,500 per mile—furnished by the state and the total low bid average is slightly under $40,000 per mile. *Engineering News-Record* erroneously reported this average cost as near $50,000 per mile, in the issue of March 10, p. 448.

Boston Builders Break With Union Employees

The latest developments in the dispute between employers and employees in the building industry in Boston are a definite break between the two factions, a partial resumption of construction, and the possibility of a settlement by the State Arbitration Board. Many attempts have been made to end the strike, which began Jan. 20, but all have proved unavailing. The strike was a protest against the offer of the employers of a base rate of 90 cents per hour for the 1921 schedule. Employees demanded a higher rate, which the builders were not willing to give. Employers asserted that they were willing to make agreements with the unions any time before March 10 on a 90-cents-per-hour basis, which the unions have steadfastly refused to accept.

On March 11 several building jobs which had been struck and had been idle since Jan. 20 began again with non-union labor and with what union labor wished to work at the 90-cent rate. Officers of the Building Trades Council of Boston assert that the Boston builders are taking advantage of the situation in trying to force a reduction in the wage scale.

The employers agreed to accept Mayor Peters' plan, whereby those trades receiving $1 an hour under the 1920 schedule were to continue in that wage until May 1, after which a reduction of 10 per cent would be effected. This the unions also rejected. Arbitration of the question is now talked of, but it is understoood that the contractors will not arbitrate upon a 90-cent basis, but upon an 80-cent basis.

Jurisdictional Awards to Be Published by Board

According to a resolution passed by the National Board for Jurisdictional Awards in the Building Industry on March 12, the decisions, rules and other records of the board will hereafter be published in an official pamphlet edition, besides being made known through general publication channels. This decision follows solicitation by unauthorized parties for contributions, advertisements and subscriptions to defray the expenses of the publication of the board's decisions.

Building Officials' Conference in Cleveland

The seventh annual meeting of the Building Officials' Conference is to be held in Cleveland, Ohio, Apr. 27-29. The headquarters will be at the Hotel Statler. The meeting is being arranged by F. W. Lumis, secretary-treasurer, Springfield, Mass. Consideration will be given to a number of subjects of interest to building inspectors and superintendents, and several excursions will be made to various building material plants in the vicinity of Cleveland.

Harrisburg Building Mechanics Ask Wage Increase

According to recent information from the Harrisburg, Pa., Building Contractors and Employers' Association, the union plasterers have asked for an increase from 87½ cents to $1.15 an hour. It is also understood that the painters will ask for an increase of 30 cents an hour, making their hourly wage $1. The new wage scale of the plumbers calls for an increase from 80 cents to $1 an hour, say press reports.

Youngstown Builders Plan 20 Per Cent Wage Cut

It is reported that the Youngstown Building Trades Employers Association, Youngstown, Ohio, is planning to submit to the trade unions a schedule calling for a 20 per cent wage reduction in the new agreements which become effective May 1. Approximately 5,000 workmen are involved. It is understood that journeymen will oppose the proposed reduction.

Union Carpenters Cut Own Wages

Union carpenters of Birmingham, Ala., have voluntarily cut their wages 14 per cent, the reduction becoming effective March 15. The announcement of the reduction was made by the secretary of the carpenters' district council. The reduction was made in the hope that it might stimulate home building, and followed a reduction of 11 per cent in the wages of union bricklayers.

To License Builders in New Jersey

A bill introduced in the New Jersey legislature by Assemblyman Eldridge, of Union County, proposes to create a state board for licensing master builders in the various trades followed in the state. The board is to be named by the governor and to consist of an architect, a civil or mechanical engineer, a master builder and two journeymen, to serve without pay.

Atlanta Votes for Water-Works and Other Improvements

At an election held on March 8 the voters of Atlanta, Ga., approved a total bond isssue of $8,850,000 for use as follows: Schools, $4,000,000; water-works, $2,850,000; sewers and sewage disposal, $1,250,000; bridge and viaduct, $750,000. We are informed by P. H. Norcross, consulting engineer Atlanta Water Department, that besides the bonds voted on March 8 for water-works improvements, there is available $450,000 unexpended appropriation, making a total of $3,250,000. The proposed water-works improvements include: A 21-m.g.d. addition to the filter plant; a 10,000,000-gal. clear water basin; a force main 48 in. in diameter and 21,000,000 ft. long from the river station to the filter plant; additional pumps at the river station, together with coal and ash handling equipment a new river intake, and preliminary settling basins; additional distributing mains. Plans for the filter plant and clear water basin are now being prepared and it is expected that work will be started immediately.

Contract to Rebuild Corpus Christi Causeway Let

A treated-timber-pile causeway is to replace the concrete causeway at Corpus Christi, Texas, which was destroyed by a hurricane in September, 1919. An article describing the storm and its effects is contained in *Engineering News-Record*, Nov. 13-20, 1919, p. 848. The contract for the construction of the causeway has just been let by the county engineer of Nueces County to Austin Brothers Co., of Dallas, Texas, the contract price being in excess of $300,000.

Ask to Resume Work on Hudson Bay Railway This Year

On March 16 a resolution asking the government to resume work on the Hudson Bay Railway was introduced in the Canadian House of Commons by J. A. Campbell of Nelson, Man. Hon. J. D. Reid, Minister of Railways, stated emphatically that no further work would be done on the road this year, the only reason being financial stringency, which rendered it necessary to postpone construction work until conditions were more favorable.

Brick Makers and Government Bureaus To Study Brick

Negotiations are in progress looking to a co-operative agreement between four associations of brick manufacturers and the U. S. Bureau of Mines and the U. S. Bureau of Standards. The plan is to make a comprehensive study of certain of the fundamental problems in ceramics which are confronting the manufacturers of brick. A substantial sum is to be made available for that purpose. The associations which are parties to the negotiations follow: The Face Brick Manufacturers Association; The American Common Brick Manufacturers Association; The National Paving Brick Manufacturers Association; The Hollow Building Tile Manufacturers Association.

San Francisco Contractors Fined —Three More Indictments

Of the five San Francisco contractors who were indicted by the Grand Jury last fall on the charge of illegally combining to add 12 per cent to bids on grading jobs, four entered a plea of guilty and were sentenced to pay a fine of $1,200 each. The case of the fifth contractor, William Scott, who entered a plea of not guilty, has not yet come to trial. Grand jury indictments were returned on March 10 against three more contractors, Peter Montague, Gor-

don S. Chamberlin and Arthur Granfield, charging violation of the Cartwright anti-trust act, as did the original five indictments. Reference to the original indictment appeared in *Engineering News-Record* Sept. 23, 1920, p. 626 and Oct. 7, 1920, p. 722.

Plumbers Get Jail Sentences

Thirty-one of the thirty-eight individuals and firms, master plumbers, indicted as a result of disclosures made by the Lockwood committee in its investigation of building conditions in New York City, were sentenced March 22, six men receiving 30-day sentences and two, ten-day sentences. Fifteen firms were fined a total of $30,000. The defendants had pleaded guilty to the indictment charging them with violation of the State anti-trust law, through the operation of a "code of practice" designed to eliminate competition.

Pacific Northwest Contractors Hold Joint Session

At the joint convention of the Associated General Contractors of the Pacific Northwest, and the Northwest Master Builders' Association, in Spokane, March 3-5, action was taken dissolving the Northwest Master Builders Association, the withdrawal from it of Spokane and Portland builders, and changing the name to Washington State Contractors' Association. The new association will include builders of the state, outside of Spokane. Spokane and Portland builders will join the ranks of the general contractors. The General Contractors took action to change the name of its organization to the Association General Contractors of America, Pacific Northwest Chapter, and elected the following officers: Matt M. Dougall, Portland, president; I. N. Day, Portland, secretary-treasurer; S. C. Morin, Spokane, Frank J. Walsh, Tacoma, and R. E. Miller, Seattle, vice-presidents.

David Thacker, Yakima was elected president of the Washington State Contractors' Association.

Number Unemployed Decreases

According to reports made from data collected by the United States Employment Service, there was a decrease of 1 per cent in industrial idleness during the month of February. The report is based upon information received from 1,433 firms in sixty-five principal industrial centers. The report shows that for the last day of January there were 1,643,253 workers employed as against 1,626,958 on Feb. 28. Agents of organized labor assert that the actual idleness is not indicated by these figures.

Returns show that the greatest increase in unemployment in February was in the iron and steel industry, which reported an aggregate decrease in labor employed of 7.3 per cent. The decrease in employment in railroad labor shops was 6.6 per cent. A total decrease of 56,896 employees was reported in the following industries: Iron, steel and other products, railroad repair shops, chemicals and allied products, liquor and beverages, miscellaneous, food and kindred products, stone, clay and glass products, paper and printing, and tobacco manufacture. Industries reporting increases in employment during February were vehicles and land transportation, textiles and other products, leather and finished products, lumber and its manufacture, metal and metal products other than iron and steel. The total in these six classes was 40,601. The resumption of work in Detroit automobile factories placed 20,417 men in work in February who presumably were without work in January.

Thirty-six cities reported a decrease in the number of employed of 60,235, while twenty-nine cities reported a total increase of 43,904.

Explosion Wrecks Chicago Elevator

The working house of the Chicago & Northwestern Ry. grain elevator at 122d St. and the Calumet River, Chicago, was wrecked by a dust explosion March 19, with the loss of four lives and a great quantity of grain. The building had a machinery room of structural steel cased in concrete, supporting a group of cylindrical concrete bins, these being surmounted by a cupola about 93 ft. high having structural steel framing with light curtain walls of reinforced concrete built up by the cement-gun, as described in *Engineering News-Record*, April 25, 1918, p. 819. The total height was about 215 ft. and the bins had a capacity of 931,000 bushels. The storage bins in the rear of the building have a capacity of 10,000,000 bushels.

It is reported that a slight explosion occurred first, which is a characteristic of dust explosions. This seems to have been in the driers and to have been followed by the main explosion which swept through the structure. The elevator was built in 1918.

American Architects Begin on Louvain Reconstruction

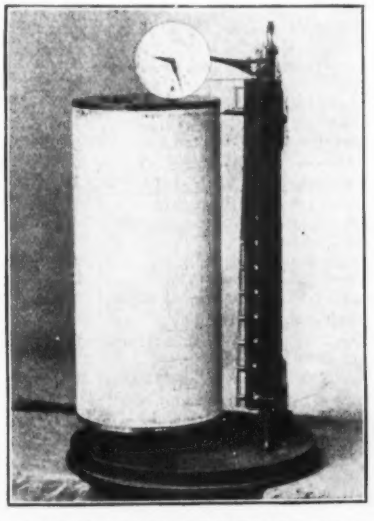
Whitney Warren, of the firm of architects of Warren & Wetmore, New York City, has gone to Belgium to begin plans for the reconstruction of the Louvain Library, destroyed by the Germans in 1914. He was accompanied to Belgium by two other American architects. After preliminary plans have been made the architects will return to this country to finish them. It is expected that the cornerstone of the library will be laid some time in July of this year.

Combined Water-Level Recorder and Flow Meter

A combined water-level recorder and flow meter has been perfected by John L. Stevens, consulting engineer, Portland, Ore., and is now being made and sold by Leupold Voelpel & Co., Portland, Ore. The recorder (see view) is a complete water-level recorder in itself, designed for small conduits, weirs or other devices where the range of heads does not exceed 2 ft. The flow meter is a separate integrating attachment that may be put on at any time. The combined instrument is covered by patent 1,356,322.

The purpose of the flow meter is to save the labor of computing the volume of flow from the record of water levels. It may be set to record the total volume of water passing the instrument in acre-feet, gallons or any other unit desired. It is operated by an adjustable spiral cam that may be set for any weir, headgate, canal, flume or ditch that is rated, or for any device or condition where the height of water is an index of the flow.

A pen carriage is moved up and down by a float resting on the water. The pen marks a line on the record paper fastened around a drum that is turned by an eight-day clock inside the drum. The combination of these two



WATER-LEVEL RECORDER AND FLOW METER

motions makes a record of the rise and fall of water. The record of heights may be made either to actual size or to one-half actual size by a simple adjustment of the line to the float.

The flow meter operates somewhat on the principle of a planimeter. A friction wheel resting on top of the drum is turned by it. The angle this wheel makes with the direction of motion of the drum is made to vary adjustably with the height of water. A suitable gear train causes hands to indicate on a graduated dial the number of revolutions made by this friction wheel. By a simple adjustment of a spiral cam and the use of an integral multiplier the revolutions thus indicated are readily converted into acre-feet, gallons, cubic meters or any other unit of volume flowing in any rated conduit or passing any weir, headgate or other measuring device.

A check is always had on the record

of the flow meter through the simultaneous records of water levels. Thus the convenience of the water meter is secured with the additional advantage of being able to check the results and determine rates of flow if desired.

New Type of Trenching Machine

A new type of trenching machine, with full multipedal traction has been placed on the market by the Austin Machinery Corporation. It is designed to turn practically within its own radius, has full caterpillar traction and is a "one-man" machine.

The full multipedal traction steers through heavy friction clutches—one on each side—its action in this respect being similar to the military tank. It is of sufficiently light weight to handle trenches for house connections, sewers, etc. The machine will cross sidewalks, climb over a curb, cross bridges, and travel over all types of pavement.

A screw hoist raises and lowers the digging arm automatically, and the endless chain and buckets are of standard type. The screw hoist also acts as a lever to force the buckets to dig, by crowding the bucket line against the face of the ditch or cut.

A cleaning device takes care of the sticky dirt, and scrapes out each bucket as it passes a point at the head of the excavator boom, directly over the conveyor belt. This can be adjusted to deliver the excavated material to either side of the machine.

The gasoline engine is of four cylinder four-cycle type, cooled by an enclosed radiator. Some of the details which are of interest to sewer, water, gas, electric and oil pipe line contractors and corporations are as follows:

The digging width with 18-in. buckets, will run from 20 in. to 28½ in., and with 24-in. buckets, from 26½ in. to 29 in. The standard boom will dig up to 6 ft. in depth, although the machine may, with extensive equipment, dig 8 ft. deep.

The conveyor belt is reversible, so that it can deliver dirt on either side. An important feature of the working performances is its interchangeability for digging trenches with vertical banks or small ditches with sloping sides.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.58	$4.25	$3.75	$3.58	$3.86	$5.90	$4.70	$5.00	$5.00
Structural rivets, 100 lb.	5.08	.....	7.05	5.08	5.50	6.90	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb.	3.00	3.75	3.85	3.48	3.88½	4.37½	3.60	4.50	4.25
Steel pipe, black, 2½ to 6 in. lap, discount	39%	45.65–5%	40@45%	3½%	46.9–5%	29@33%	36½@42½%	40%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	64.00	66.20	64.10	67.80	70.00	87.65	75.00	80.00
Concreting Material:									
Cement without bags, bbl.	3.10	3.00	2.85	2.17	2.60	3.10	3.09	3.10	4.28
Gravel, ¾ in., cu.yd.	2.50	2.62½	1.75	2.75	2.00	2.50	2.50	1.50	1.50
Sand, cu.yd.	1.25	1.52½	1.75	2.75	.75	1.10	1.65	1.50	1.50
Crushed stone, ¾ in., cu.yd.	2.15	2.50	3.20	2.75	2.25	3.50	2.50	3.50	2.10
Lime, finished, hydrated, ton.	21.00	18.00	25.00	20.00	29.00	32.00	25.40	27.00	32.00
Lime, common, lump, 200 lb. bbl.	3.30	2.00	2.50	1.65	2.00	3.20	2.25	3.25	16.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	48.00	35.00	45.00	53.00	41.00	47.00	27.00	35.00	120.00
Common brick, delivered, 1,000.	21.70	12.00	25.00	15.00	18.00	16.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	0.14	0.21	.12	.06	.11	12½	.13	.25
Hollow partition tile, 4x12x12, block	2444	.15	.19½	108	.....	11	14½	.11	.....
Linseed oil, raw, 5bbl.lots, gal.	.73	.74	.88	.82	.78	.97	.79	.79	.98
Common labor, union, hour.	.75@.80	.35	60@1.00	1.00	50	50@.63½	.81½	.75	.....
Common labor, non union, hour.	.....	.25	.40@.60	.50	50	37½@.50	.50@.55	.50	.30@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. **New York** quotations are at warehouse, except cement and brick, which are delivered, and tile, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on " " ath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses, except C. I. pipe, which is mill price, plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

The principal price changes are in lumber and linseed oil. Pine is highest in Montreal, $120 per M ft. b.m., against $35 in Atlanta, but the Canadian city looks for an early decrease. Atlanta is down from $37.50 to $35, while Chicago reports that the decrease of $2 is only a minor fluctuation and does not represent the state of the lumber mar[illegible] as a whole. Prices are down $1 in Minneapolis and San Francisco. Linseed oil dropped as follows: 15c. per gal. in Montreal, 4c. in Minneapolis, 3c. in Chicago and Atlanta, 1c. in Dallas.

In Seattle, sand and gravel sells for $1.50 per cu.yd., loaded on trucks or railway cars. According to the Pioneer Sand and Gravel Co., the price at pits 12 to 40 miles from Seattle is 75c. per cu.yd. on scows, while at a pit 40 miles from the city the price is 50c. In New York price of gravel was lowered 50c., March 23, making the present price $2.50, as against $3 since June, 1920.

Steel prices changed only in Montreal, San Francisco and Dallas. Structural rivets can now be bought for $7.05 in Dallas, against a former price of $8.50. Reinforcing bars are available at $3.60 in San Francisco, drop of 15c., while the decline in Montreal is 25c. Steel beams are down 75c. in Montreal; rivets, 25c. Cast iron pipe in Montreal is now $80 per ton, instead of $90.

The "liquidation" of labor continues. In Chicago continued unemployment has forced unskilled common labor down to 50c. per hour, whereas recently rate was 60@65c. Montreal reports: "Labor plentiful, work scarce." In Colorado 97 Cheyenne building crafts are striking against a dollar a day decrease. Denver contractors and unions have practically reached agreement on a dollar reduction. Following this settlement in Denver the lumber interests are pushing a campaign to show that now is the time to build. The National Association of Builders' Exchanges forcasts a general wage reduction.